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ARCHIVES OF OPHTHALMOLOGY.

DETACHMENT OF THE RETINA.[1]

By DERRICK T. VAIL, M.D., F.A.C.S., Cincinnati, Ohio.

AMONG the unsolved problems in ophthalmology there is none that is shrouded in deeper gloom than idiopathic detachment of the retina.

The ætiology is unknown. The pathogenesis is a mystery. The medical treatment is purely empirical and the many operations thus far advocated for its cure are not only disappointing in results but often actually disastrous. There is only one well founded hope in the disease and that is, if left alone there is a bare chance (1%) of spontaneous recovery.

It is a sad commentary on the sincerest efforts of the world's best brains working in ophthalmology for over seventy-five years seeking a cure for detachment of the retina, to say that so far as a reliable cure is concerned nearly all is vanity and vexation of spirit.

That a cure is often possible we must acknowledge from the fact that in those detachments associated with albuminuria in pregnant women nearly all recover if gestation is terminated early enough, that many cases due to trauma recover by rest-in-bed treatment along with the employment of simple therapeutic measures and that spontaneous cures occasionally occur in the idiopathic form even where no treatment is instituted.

The object of this paper is to offer some new thoughts with the hope that they may stimulate others and arouse discussion

[1] Read by invitation before the Section on Ophthalmology, New York Academy of Medicine, May 17, 1920.

that may lead to a better understanding of the subject and to better results in the treatment of this dread disease.

ÆTIOLOGY.

In the first place let us abandon the teaching that detachment of the retina is caused by intraocular strain, violent muscular strain, stooping, vomiting, constipation, sneezing, seasickness, etc., for if these produced the disease who would escape?

Next, let us acknowledge that myopia is not a cause, for in spite of the fact that approximately 50% of the cases occur among myopes, it is fair to estimate that not over one in one thousand cases of myopia ever has retinal detachment. Myopia *per se* is not a cause, otherwise the disease would be a scourge. How then may we account for the fact that approximately 50% of the cases occur among myopes? Certainly it is not because the sclerotic wall is too large for the vitreous contents thus causing spaces to form behind the choroid and in front of the retina as taught by L. Mueller and others, for in most of the cases of detachment in myopia the amount of bulbar enlargement is negligible, moreover we see large numbers of patients where the eyeball is greatly enlarged where no detachment occurs, and contrariwise we see many detachments among hypermetropes where the eyeballs are small.

My theory is that disease of the pars ciliaris is the essential factor predisposing to detachment, especially that form which tends to travel forward to finally reach the ciliary processes. No name has been given to this pathological entity; it is allied to anterior choroiditis or equatorial choroiditis. This disease is more frequently seen among myopes, perhaps incited by the drag on this region by the tensor choroidea muscular fibers in the straining effort these myopes employ in trying to see off without lenses or with under-correction, and aided perhaps by atrophy of Mueller's ring muscle fibers lying in close proximity to the ciliary processes. This region becomes the seat of chronic congestion in such myopes and therefore subject to inflammation especially, in the presence of chronic infection in the blood supply. But fully 25% of the cases of detachment do not have myopia. I have searched the region

of the ora serrata in the unaffected eye in quest of equatorial choroiditis among hypermetropes with detachment of the retina in one eye, and have found it in nearly every instance. What produces the anterior choroiditis? We do not know unless it be bacterial poisons in the capillary blood stream or chronic septicæmia from showers of pathogenic germs thrown in the circulation from hidden and silent areas of sepsis elsewhere in the body as abscesses in the bone about the apices of the teeth, septic tonsils, chronic ethmoiditis or other accessory nasal-sinus disease, remote neglected chronic suppurations, etc. These autogenous infections are very common and they tend to settle in a strained or congested part; that is as much as we know about it at present.

Let us look further into the list of causes as enumerated in our modern textbooks of reference. Horner studied 300 cases and submitted the following statistical table with reference to predisposing causes:

Myopia	144 cases	48.0	per cent.
Trauma	49 "	16.3	" "
Iritis and Uveitis	11 "	3.6	" "
Choroiditis	10 "	3.3	" "
Hemorrhagic Diathesis	23 "	7.6	" "
Congenital Anomalies	2 "	0.6	" "
Congestive Causes	11 "	3.6	" "
Opacities in the Vitreous	22 "	7.6	" "
Idiopathic	28 "	9.3	" "

(Woods's *Encyclopedia*, vol. xv., 11,214.)

It is significant that there was undoubtedly present among many of these three hundred cases a disease affecting the ciliary zone. Even the idiopathic cases may and probably did have unrecognized disease of this region.

In 1912 in a paper on "Detachment of the Retina" read at the Niagara Falls meeting of the American Academy of Ophthalmology and Oto-Laryngology I proposed the theory that the symptom, detachment of the retina, was the logical consequence of paralysis of secretion of the aqueous humor due to disease or shock affecting the secretory cells of the ciliary processes. (See "An Inquiry into the Results of the Established Treatment of Detachment of the Retina, and a New Theory,"

Annals Ophthal., Jan., 1913, and Trans., 1912.) Quoting from that paper:

"My theory is that there is a paralysis of the secretory function of the ciliary processes. This means that the secretion of aqueous is suddenly arrested. There being nothing wrong with the drainage channels within the eye, the watery elements find ready egress thus causing a minus tension. Leber found 90% had minus tension. The withdrawal of normal tension causes passive hyperæmia of the blood vessels of the tunica vasculosa. This allows diapedesis and transudation. The vitreous contracts because it loses its percolating supply of aqueous which soon drains off through the efferent channels which are wide open, and the fibers of the vitreous naturally contract as a sponge would contract after losing its water."

It is common knowledge that in detachment of the retina the vitreous body is shrunken and toughened. Leber and Nordensen held that at first there are fibrillar changes in the vitreous which cause shrinkage and occasion traction on the retina through adhesive bands; this, they claim, drags the retina off its bed and causes rents in it for fluid to pass from the vitreous cavity back behind it (traction theory). Raehlmann held that there was serous exudate from the choroid which diffuses through the retina and hyaloid according to ordinary physical laws. The watery elements of the choroid-exudate diffuse on through, leaving the heavier albuminous exudate to become concentrated behind the retina, and accumulating there, lifts it off its bed (diffusion theory). Collins and Mayou state the objection to the diffusion theory is that in retinal detachment the tension of the eye is not increased but decreased and that Raehlmann's theory necessitates the disappearance of at least a corresponding quantity of the contents of the vitreous chamber. This disappearance of normal vitreous contents, they state, is exceedingly difficult to account for. The same criticism holds against Leber and Nordensen's theory. Deutschmann showed by experiment that when the ciliary body was extirpated there was complete cessation of aqueous production and in a short while the vitreous shrunk and was apparently absorbed.

It seems strange that no one has suggested that the reason the vitreous shrinks in detachment of the retina is because the

aqueous has ceased to form; that the secretory cells are paralyzed from some cause or other.

Violence alone does not seem to produce detachment of the retina unless some such disease of the ciliary zone, as suggested in the term anterior choroiditis is present. In proof of this there is nothing which produces greater violence to the intraocular structures than extrusion of the greater part of the vitreous such as occurs in the cataract operation in the case of "squeezers." Everyone who operates for cataract will grant that, while theoretically every case of profound vitreous escape should have detachment of the retina, the fact is that it does not occur in more than 5% of such cases, and I believe it is fair to say that in each case where it does occur there was a predisposing pathological condition already present in the eye before the operation, and further, that in those cases in which detachment of the retina occurs as a late symptom, disease in the equatorial and ciliary zone eventuated because of the trauma aided perhaps by a quiet infection in this region and that finally there resulted paralysis of the secretory function of the ciliary processes.

In the case of detachments occurring as the result of albuminuria in pregnant women, in which we may see the frank evidences of plastic inflammation in the retina and elsewhere, with the ophthalmoscope, it is interesting and significant that rapid replacement of the retina with restoration of normal tension and often normal vision usually occurs if the gravid uterus is promptly unloaded. It is a clinical fact that induced labor soon rids the blood of the toxic substances in these curious cases and the general anasarca, the pronounced albuminuria, the uræmia, the eclampsia and in fact all the symptoms including the neuro-retinitis disappear magically. Facts are stubborn things and will not be argued away. It must be that the cause being removed, the exudations and poisons undoubtedly present in these cases also disappear, and the secretory function of the ciliary processes which was paralyzed by them, speedily returns and establishes a cure.

THE MECHANISM OF DETACHMENT OF THE RETINA.

To understand the mechanism of detachment of the retina we must begin at the beginning and consider briefly that part

of the embryology, histology, anatomy, and physiology of the retina and ciliary processes which bears on the subject, for it is from these sources of knowledge that we must base our explanation of the disease.

In the embryo the primary optic vesicle soon becomes invaginated, as regards its anterior half, forming the optic cup. The invaginated portion develops into the retina proper. The posterior half becomes attenuated and finally reduced to a single layer of polygonal cells highly pigmented and finally constitutes the pigment layer of the retina. The rods are pressed against this pigment layer by the normal intraocular pressure contained in the vitreous body. The space between the retina proper and its pigment layer never becomes completely obliterated. This interspace is occupied by a clear fluid substance constituting a modified lymph. It is well-known that the pigment layer adheres to its basement membrane, the lamina vitrea of the choroid, in retinal detachment, and it is taught that at no place is the retina adherent to its pigment layer excepting at the optic-nerve entrance and at the ora serrata. The sustentacular fibers of Mueller hold the integrity of the retina against splitting in case of ordinary strain but these fibers do not pass across the space lying between the rods and the pigment layer. At the pars ciliaris the retina completely loses its structure and passes on forward as a single layer of cells being, however, in contact with the pigment layer which also continues forward.

From this anatomical description it will be seen why the retina separates from its pigment layer as soon as there exists a marked lowering of intraocular tension together with a transudation of serum from the choroid. It is a well-known clinical fact that the ocular tension in detachment of the retina is always less than normal. It usually falls to 20*mm* of mercury or even less. The tension must fall because the aqueous secretion is arrested. If the aqueous secretion continued and serum exudate from the choroid was added the tension would surely become plus. The normal vitreous and aqueous humors are identical excepting that in the former there exist bundles of clear fibers, in the spaces of which aqueous abounds like water in a sponge. The normal function of the ciliary processes is to secrete the aqueous as a constant stream in the vitreous

chamber as well as filling the aqueous chamber. In health there is a nice physiological balance maintained between the secretion of aqueous and its outflow.

If, from any cause, the secretory cells of the ciliary processes are damaged from progressive disease there will come a time when a slight insult to the eye like dazzling, straining, etc., will cause paralysis of function and the result will be that little or no aqueous will be secreted. Normal tension being thus lowered there is negative pressure against the retina and the choroidal vessels become passively hyperæmic allowing serum to pour out through the pigment layer to reach the anatomical space that exists between the rods and the pigment layer. Here the thick serum collects and the retina is separated. This serum is probably hypertonic as compared with the vitreous and so the osmotic pressure is under the retina; this is sufficient to strip the retina off its bed and even to burst it in some cases.

The aqueous of the anterior chamber is highly albuminous in detachment of the retina. Suker of Chicago has written me that he tapped the anterior chamber and drew off the aqueous in three cases of detachment of the retina and found it very albuminous. This in the presence of hypotony strongly argues that the normal aqueous flow has ceased.

The detached retina holds its integrity for a while by virtue of its sustentacular fibers and spider cells but rents or lacerations usually occur owing to the higher osmotic pressure in the subretinal fluid.

THE MECHANISM OF AQUEOUS SECRETION.

It is interesting to apply the knowledge of modern physiology to the study of the aqueous secretion. Macleod (*Physiology and Biochemistry in Modern Medicine*, 1919, page 420) states the secretion of water and inorganic salts from the blood may be dependent to a certain extent at least on differences in osmotic pressure. We know when an osmotically active substance is confined in a tube having one end closed with an impermeable membrane and the other end closed with a permeable membrane and the tube be immersed in water, a continuous current will issue from the permeable end so long as

there remains any osmotically active substance within the tube. The living secretory cell is the microscopic tube containing the osmotically active substance, the end next to the basement membrane the impermeable and the other or free end the permeable one. So long as the content of the cell is osmotically active the cell will secrete water. The process is, however, more complicated when we consider that the cell must be under the control of the nervous system or else receive its impulse to carry on abstraction of water from the blood and discharge it into the vitreous chamber as aqueous under the influence of a hormone. A hormone is a chemic substance produced in an organ which being carried to an associated organ by the blood stream excites in that organ a functional activity. There are two theories as to the effect of such a hormone on the living secretory cell, one is that there is a permeability of the free end of the cell brought about by alteration of the surface tension by the migration of electrolytes to this end of the cell through electric influence, thus favoring the passage of the water elements and some of the inorganic salts. The other theory is that there exists a ferment in the cell called zymogen and these zymogen granules cause the molecules within the cell to imbibe water until they swell and burst at the periphery of the cell the contents to be discharged as water bearing some zymogen and inorganic salts. The residual cell-content becomes concentrated by the discharge of its water and it in turn attracts more water to go through the same process. By this physiologic process there is a constant flow of water from the secretory elements of the ciliary processes.

Ninety to 92% of blood plasma consists of water. The specific gravity of the aqueous is 1.005 while that of the blood is higher, viz., between 1.040 and 1.065. The velocity of the blood in the capillaries is one half of one millimeter of distance in one second. Thus the hypertonic plasma is in slow contact with the cell and its osmotic pressure is toward the secreting cell.

Certain glands like the salivary have periodic activity and are under direct nervous control whereas other glands like the ductless and the ciliary are not under nervous control, at least in the same sense, but are continuous in function. Modern

physiology teaches that these are under hormone control. Those glands which are under periodic nervous control secrete during activity a thick fluid containing a large amount of organic matter, while those under hormone control incite a constant flow of thin, watery fluid containing scarcely any organic matter.

The hope contained in this tedious recital of some of the simpler processes involved in the mechanism of aqueous secretion is that the active ferment, hormone, or zymogen which incites the flow of aqueous may be discovered, extracted and used with success in cases where there is a lack of aqueous flow in a manner analogous to the action of secretin on the pancreas.

TREATMENT OF DETACHED RETINA.

In applying these principles to the therapy of detachment of the retina the problem seems to be to reverse the vicious osmotic pressure and establish if possible a hypertonic vitreous content and a hypotonic subretinal content, thus causing higher osmotic pressure within the walls of the vitreous chamber in front of the retina, and thereby convert a *vis-a-tergo* to a *vis-a-fronte*. In spontaneous cures the reëstablishment of aqueous secretion accomplishes this result. The therapeutic measures that have been successful in curing cases seem to me either to effect this change of osmotic pressure or else establish a makeshift.

If trephining the sclera to drain the subretinal sac cures, it would be by destroying the osmotic pressure of the fluid behind the retina by draining it off as fast as it forms.

The benefit derived in cases of subconjunctival injections of salt water, dionin, etc. may be explained on the theory that they tend to lower the osmotic subretinal pressure. Pilocarpine increases secretion and atropine is thought to retard intraocular drainage and so the benefit of pilocarpine may be found in the increased aqueous secreted from its use while atropine may tend to block the channels of exit and raise intraocular tension somewhat, thus either may to a certain limited degree inhibit the perverted osmotic pressure.

As for creating adhesions between the retina and its pigment

layer by injection of irritant solutions like iodine in the subretinal sac, cutting through the retina to induce adhesive inflammation, suturing the retina to its bed, scarification of the sclera, galvano-puncture, and all such measures, they are to be strongly condemned for the reason that even if successful they are open to the stern objection that they are designed to create an adhesion through plastic exudate and cicatricial formation between the ultimate layers of the retina where no adhesion ever existed without destruction of vision. This theory seems founded on vicious ignorance of the embryology and physiology of the retina and its practice is cruel.

Time forbids me to say more. I only wish to call your attention again to my paper of 1912 wherein I published accurate reports from 281 leading American ophthalmologists going to prove that by the employment of every known method of treatment and operation, the cases of cure were of startling paucity figuring about one case in one thousand. Two hundred and fifty of those busy ophthalmologists with an average experience of over twenty years had never seen a single cure spontaneous or otherwise. In the light of this, anyone may be pardoned for abandoning the beaten paths and daring to seek and explore new avenues of thought with the hope that some one of them may lead to the light.

FURTHER EXPERIENCES WITH TREPHINING AND ASPIRATION IN RETINAL DETACHMENT.[1]

By Dr. EDGAR S. THOMSON, New York.

THIS method of operating on cases of retinal detachment was reported by Dr. T. H. Curtin and the writer in the *Transactions of the Section on Ophthalmology of the A. M. A.* for the year of 1915. A further contribution to the subject was printed in the *Annals of Ophthalmology* for January, 1916. The first operation was done by Dr. Curtin on October 12, 1914. Up to the present time about seventy-five operations in all have been done by various members of the staff of the Manhattan Eye, Ear, and Throat Hospital, with seven successes. The successful cases are briefly as follows:

Case 1.—B. Male, 21, spontaneous detachment of twelve days' duration in lower half of left retina. L. V. = Hand movements. Trephine, October 12th, aspiration ten days later through trephine opening, and 25*m* of fluid withdrawn. Complete reattachment except for a very small area over trephine opening. November 16th, L. V. = $\frac{1}{4}\frac{0}{0}$ w. — 1 cyl. ax. 180°. January 27, 1915, L. V. = $\frac{2}{3}\frac{0}{0}$ w. — 1.50 cyl. ax. 180°. He was last seen in May, 1918. The conditions were unchanged. Vision was normal and the reattachment was complete. Case reported in *Tr. Sec. of Ophth. A. M. A.*, 1915.

Case 2.—W. Male, 23. Struck in right eye November 13, 1914. Came to hospital December 8th, with large detachment in upper and outer part of field. R. V. = Fingers at one foot. Trephine December 12th by Dr. Thomson. Aspiration through trephine opening December 22d and 20*m* of fluid withdrawn. Complete reattachment, except a

[1] Read before Section on Ophthalmology, New York Academy of Medicine, May 17, 1920.

small area, near a choroidal spot in lower part of field. R. V. = $\frac{1}{10}$. Three months later no change had occurred. Case reported in *Tr. Sec. of Ophth. A. M. A.*, 1915.

CASE 3.—F. Female, 54, cataract extraction L. in 1912. Spontaneous detachment lower part of field October, 1915. Trephine and aspiration done by Dr. Curtin two weeks later. Reattachment except for small area near opening. L. V. = $\frac{1}{10}$ with lens. Case seen seven months later and found unchanged.

CASE 4.—H. Male, 45. Flat spontaneous detachment in lower part of field for seven months. R. V. = $\frac{1}{10}$ (eccentric). May 19, 1916, trephine and aspiration by Dr. Thomson and 12*m* of fluid withdrawn. Complete reattachment. June 5, '16, R. V. = $\frac{1}{10}$ w. $-$ 3 ⊃ $-$ .50 ax. 15°. Last seen September 23, 1919. Condition unchanged. R. V. = $\frac{1}{10}$ + w. $-$ 4 ⊃ $-$ .75 ax. 15°. This eye had an old sun-spot and $\frac{1}{10}$ is probably the best vision he had had for some years.

CASE 5.—R. Female, 32. Large spontaneous upper detachment in right eye for three months. R. $-$ 10 D. L $-$ 2D. R. V. = hand movements. February 11, 1916, trephine and aspiration by Dr. Thomson and about 30*m* of fluid withdrawn. Reattached but detached below later. Seen March 10th, with two large pouches below. May 9th, second trephine and aspiration below. Complete reattachment. June 6, R. V. = $\frac{20}{100}$ w $-$ 6. April 2, 1919, R. V. = $\frac{20}{100}$ + w $-$ 7. Some diffuse choroidal changes but eye otherwise in good condition. Married and mother of a child six months old.

CASE 6.—B. Male, 62. Seen September 14, 1916. Left eye lost by retinal detachment six years previously. R. V. = fingers at 2 feet in lower field. Vision in right failed early in July, 1916. Flat detachment in lower half of retina. Had chronic interstitial nephritis. October 7, 1916, trephine and aspiration by Dr. Curtin and 15*m* of fluid removed. Complete reattachment. October 30th R. V. = $\frac{20}{100}$ + w. + 2.50 ax. 90°. April 20, 1920, condition unchanged. Some floating vitreous opacities.

CASE 7.—G. Male, 26, detachment R. lower 10 days. R. V. = $\frac{20}{100}$ (eccentric). Trephine and aspiration September 26, 1919, and 10*m* of fluid withdrawn by Dr. Dean Foster. Complete reattachment. L. V. = $\frac{1}{10}$. No change to date.

The remaining cases were all flat failures, or at most, secured only temporary benefits as far as we know. It should be noted, however, that almost all cases improved temporarily but that the detachment recurred if complete adhesion was not secured.

The technic of the operation does not differ materially from

the original description, except that in our later cases the trephining and aspiration have been done at the same time. A curved incision is made about eight or ten millimeters long through conjunctiva and capsule and the sclera is bared. Two sutures are inserted into the edge of the flap and are used to retract it. A *2mm* trephine button is then removed from the sclera as far back as possible over the area of detachment and any suprachoroidal fluid is allowed to escape. The detachment is then observed with an electric ophthalmoscope and the needle of a Kny-Scheerer "Record" syringe is introduced through the choroid well back into the middle of the detachment. As long as the piston of the syringe works easily the fluid is withdrawn but if difficulty is experienced the position of the needle is shifted or it is removed, and after further ophthalmoscopic examination the needle is entered again, the object being to remove the fluid completely if possible. After all of the fluid is removed, the conjunctival flap is sutured in place and the operation is complete.

Our experiences have developed certain interesting facts. The retina does not loose its function as rapidly as has been supposed. In one case (No. 4) the detachment had existed for seven months with only a slow rate of increase and vision was completely regained. A blur remained in the field for about four months after the operation but this finally disappeared and the field is now normal. It is interesting to note an immediate increase in function when the retina is replaced. After the fluid is removed rough visual tests on the operating table will almost always show an increase of vision which seems more than would be accounted for by the mere position of the retina. This improvement almost always occurs as a temporary condition. It seems probable that in certain cases success may be secured even if the detachment has existed for six months or longer, provided perception of light in the detached area is retained.

It seems absolutely useless to operate in the presence of a well-developed retinal rent. We have never had the slightest indication of success in such cases. Also if rents develop in the course of treatment, as they are apt to do, all further operative work may as well be abandoned. It is probable that the fluid enters the sub-retinal area from the vitreous in

such cases. In case No. 4 the retina was beginning to show marked signs of thinning at the periphery but no actual rent had occured.

It is of distinct advantage to keep the patient on a low protein, low fluid, diet before the operation is undertaken. Any toxic condition should be under control particularly if the case presents any appearance of choroidal inflammation.

All the fluid must be removed at the time of the operation even if the globe collapses markedly. Any fluid which remains does not absorb, or perhaps it would be better to say that if the retina is kept from adhering to the choroid more fluid seeps in and the detachment continues. While repeated aspirations may be done the chance of success is probably better at the primary aspiration than it ever is later, though a secondary operation may prove successful as is shown by Case 5. This same case shows that a high degree of myopia is not an insuperable obstacle to success though it undoubtedly makes the prognosis much more doubtful. Myopia may diminish one or two diopters after a trephine, though it usually recurs to the full amount. Case 5 is most probably at least 1 D. lower than before the two trephines. This tendency is mentioned by Holth in his paper at the meeting of the Heidelberg Ophthalmological Society for 1913.

The larger the amount of fluid the more slender the chances of success, though a large amount of fluid does not materially add to the post-operative reaction, which is usually slight. We have removed as much as 40*m*. The presence of fluid in the suprachoroidal space is a somewhat favorable sign. It seems that such cases do better than when the fluid lies entirely in the sub-retinal space.

Marked vitreous opacities are a distinct disadvantage in the operation and such cases are apt to cloud up with further infiltrations. It seems probable that the trephine opening, by the lymphatic changes it produces, has a tendency to hold off the iritis which formerly was such a dreaded complication in retinal detachment. It may be of some benefit in holding off inflammation even where the detachment goes on to absolute blindness. The tension does not remain permanently lowered after the operation but returns to normal in a few weeks. Infection at the site of the opening does not occur as

in trephining at the limbus, probably on account of the greater thickness of the flap. Nor does a bleb exist for any length of time although there is probably some steady loss of intraocular fluid for some weeks. Ultimately the area of the opening smoothes out and it can hardly be seen where the opening was.

Finally the old difficulty of lack of retinal healing power comes into the question as actively as ever and seems in the great majority of cases to interfere with ultimate success. For this reason it is undoubtedly a mistake in the after treatment to overdo the period of rest in bed. If the retina is disposed to adhere, a week or ten days in bed is probably sufficient while if complete re-adhesion is not secured the detachment increases sooner or later no matter how long the patient is kept flat on the back.

INTRANASAL DACRYOCYSTOSTOMY.

By Dr. C. F. BOOKWALTER, Chicago

(With three illustrations on Text-Plate XIX.)

THE object of the operation is to establish a new, permanent opening from the lacrimal sac into the nose. It is indicated in cases of chronic obstruction of the lacrimal passages in lower part of the sac or in the nasal duct and not in cases with tearing due to other causes. Most of my cases presented the usual pictures of chronic purulent dacryocystitis in one stage or another but there were some with a collection of clear fluid in the sac in which tearing was the chief complaint.

The establishment of the new opening, if properly done, invariably relieves the suppuration or accumulation of fluid in the sac and there will be no tearing, if the passages from the eye to the sac are in good condition. Some cases with slit or otherwise defective canaliculi will have a little tearing with certain positions of the head. The best results, so far as tearing is concerned, are to be expected where the canaliculi are normal. The new opening will not close if properly made at operation, though some, about one out of ten in my series, require a little after treatment. The results of the operation are most pleasing to the patients, especially since its success is usually apparent almost at once and the relief is complete and permanent. My fifty-five operations were done on fifty-three patients, two having both sides done. Of the fifty-three patients, forty-four were females and nine males, the oldest being seventy-five and the youngest sixteen years of age. I have not seen a case in a small child where this procedure was indicated. The operation seems to be free from danger, there is little bleeding and not much pain. All of my cases were

done with local anæsthesia. The time required for the operation varies of course. I have never done one in less than twenty-five minutes. Forty-five minutes would be a reasonable average time. The patient should be in a hospital and on a table during the operation, and as a rule the patient will be able to leave the hospital twenty-four hours after operation. There will be a few cases, three in my series, in which the septum will have to be straightened to obtain sufficient room. I have never found it necessary to disturb the turbinates in any way.

It is not within the purpose of this paper to enter into a discussion of the diagnosis of dacryocystitis but there are certain points having a direct bearing upon the operation which should be observed in preliminary examination. The anterior part of the nose is lightly cocainized and a drop or two of 4% cocaine put in the eye. If after shrinking the nasal mucosa, a clear view can be obtained of the lateral edge of the anterior end of the middle turbinate, there will be sufficient operating room. A few cases, as I have said, will require straightening of the septum to obtain working room, but with experience the number of such cases will be negligible. Attention is next directed to the canaliculi. A No. 1 Bowman probe is passed through the canaliculus, preferably the lower, into the sac. If the canaliculi are both closed, intranasal dacryocystostomy probably will not be the operation of choice. The punctum may have to be dilated to admit the probe, but slitting of the canaliculi should not be done.

SPECIAL INSTRUMENTS REQUIRED FOR THE OPERATION.

In addition to the usual equipment for nasal operating there should be:—a No. 1 Bowman probe, West's curved gouge, West's chisel, West's right angle knife, a malleus hook, and a universal handle to which can be fitted West's punch forceps and the author's right and left up-cutting punch forceps, which are of a size that can be introduced into the sac after it has been opened.

THE OPERATION.

The patient is placed upon a table and a suitable dose of morphine given, if considered necessary. A mixture of equal

parts of a 10% solution of cocaine and a 1 to 1000 adrenalin is made. The nasal mucosa, in front of the middle turbinate, is swabbed once or twice with this mixture and a drop is placed in the eye, to be repeated once or twice as may be needed. A 2% solution of novocaine to which has been added a few drops of adrenalin is next used. With a suitable syringe the area of the lateral wall of the nose in front of the middle turbinate and above the inferior turbinate is injected with the novocaine solution, the injection being made under the periosteum. It is well to inject the anterior end of the inferior turbinate also. Using an ordinary hypodermic syringe, the novocaine is next injected from the outside. The needle is thrust through the skin just below the inner angle of the eye so that the point is within the lacrimal sac and the sac is filled with the solution. The point of the needle is then moved about in such a way that injections can be made into the walls of the sac and between the sac walls and the surrounding bone on the nasal side. It is important to anæsthetize the sac as it is the only very sensitive tissue encountered during the operation.

The first incision made in the nose is the one making the anterior edge of the intended opening and should be a little in front of and parallel to the anterior edge of the sac and nasal duct. The place to make the incision can be located approximately in two ways. The posterior edge of the sac and duct is about as far back as the anterior edge of the middle turbinate and one can measure the approximate width of the sac from the middle turbinate to make the first incision, A—B, Fig. 1. However, with experience, the position of the sac and duct with reference to the lateral wall of the nose can be estimated very well if the operator, having first put a speculum in the nose, looks back and forth from the angle of the eye to the lateral wall of the nasal cavity. This control should always be used as the position and shape of the middle turbinate vary considerably. Having made the location, the incision A—B, Fig. 1, is made, using the right angle knife, from a point a little higher than the attachment of the anterior end of the middle turbinate down to the inferior turbinate. The incision is carried to the bone. The second incision, C—D, is made with a knife having a concave cutting edge, and is car-

ILLUSTRATING DR. BOOKWALTER'S ARTICLE ON "INTRANASAL DACRYOCYSTOSTOMY."

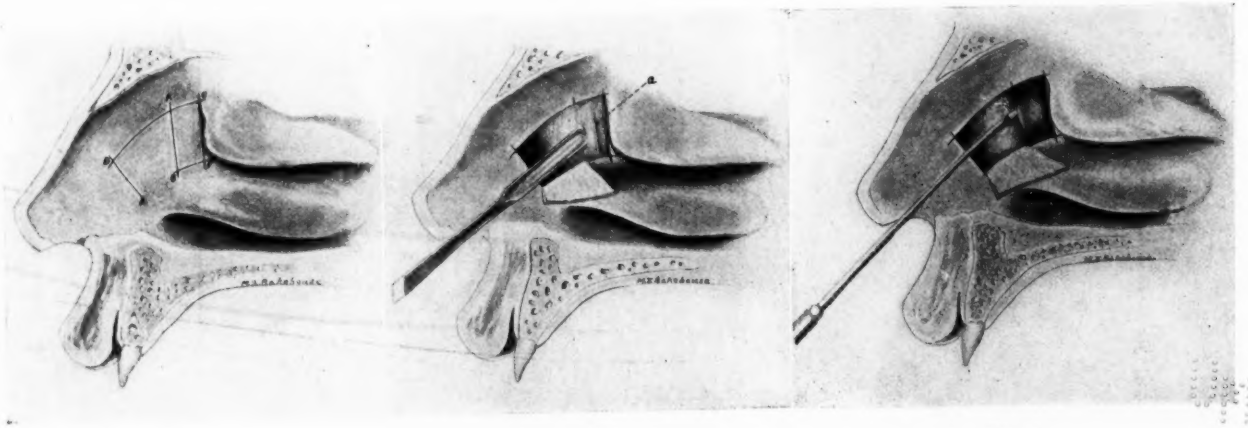

FIG. 1.

FIG. 2.

FIG. 3.

ried forward to the anterior edge of the nasal process of the superior maxillary bone. The third incision, D—E, is made with the right angle knife a little back of the anterior edge of the nasal process. There is now an area of muco-periosteum cut on three sides. This is elevated from the bone and falls down toward the floor of the nose. The object of the flap, which is to be replaced when the operation is complete, is to give a better view of the field. This step is not absolutely necessary but it is advantageous and does no harm as the flap always reattaches. After incisions C—F and F—B are made the oblong piece of muco-periosteum A—B, F—C, is removed from the nose. The position of the sac and duct with reference to the exposed bone is next to be made out and can be done in the same way as in making the incisions. In addition the articulation of the nasal process and lacrimal bone can be seen and felt with a hooked probe, A, Fig. 2, also a slight elevation can be seen in the nasal process as it curves over the sac and duct. This prominence is the first point of attack on the bone. The curved gouge is placed as in Fig. 2, and a few strokes with the hammer breaks off enough of the nasal process to expose part of the sac. A No. 1 Bowman probe is passed through the canaliculus into the sac and the nasal side of the sac can be seen to move as the probe is pressed against it. The operator is thus sure that part of the sac is exposed and it becomes simply a question of using instruments till the full width of the sac and duct is exposed from a point corresponding to the angle of the eye down nearly to the inferior turbinate. The sac is not to be opened till the bone opening is as large as described and has smooth edges. During this stage, no bone should be removed except part of the superior maxillary and lacrimal bones, but should an anterior ethmoid cell be opened, no harm is done. The nasal wall of the sac is now pushed out into the nasal cavity by pressure on the Bowman probe, or it may be pulled into the nose with a small sharp malleus hook. Using a small knife, such as is used to incise an ear drum, an incision is made into the sac and duct as far forward as possible and the full length of the exposed part, Fig. 3. The opening in the sac is completed with the knife and punch forceps till it is as large as the bone opening. This is the most difficult part of the operation, as it is hard to see

exactly how large the sac opening has been made. Of course the Bowman probe will now pass freely through the opening into the nose and by moving it around one can tell much about the condition of the opening. It is absolutely necessary for the success of the operation that the openings in the mucosa, bone, and sac be large with smooth edges. The opening always becomes smaller during the healing process which cannot be said to be complete till the edges of the opening are smooth and covered by epithelium. The flap laid down at the start of the operation is replaced and the nose lightly packed. At the end of twenty-four hours the packing is removed and the patient may leave the hospital. The patient must be instructed not to blow the nose for several days as air might be forced into the tissues.

Following the removal of the packing, the nose should be treated as after any other nasal operation. There will be a little bleeding after removal of the packing and the nasal cavity will be more or less closed by swelling of the mucosa for several days. After four to five days, the swelling will have subsided enough so that the wound can be inspected. The new opening is to be inspected every four or five days for about eight weeks. It is well to pass the eye probe occasionally to outline the opening better. Usually no after treatment other than inspection and keeping the nose clean will be required, but in some cases, enough granulations will form around the opening to partly close it or to prevent the formation of smooth edges covered by epithelium. If this occurs the excessive granulations must be removed with forceps or electric cautery to prevent the possible closure of the opening.

A case cannot be said to be cured till certain conditions are observed. All evidence of inflammation and suppuration must have disappeared. The opening must have smooth edges without granulations. Even after granulation ceases the opening contracts, but at the end of about two to three months contraction ceases in a properly operated case. There will be no tearing if the above conditions are present and the canaliculi are in good order. The eye looks perfectly normal and the patient says that it is just as good as the other eye at all times.

Of the 55 cases reported, 12 were done in 1915, 14 in 1916,

12 in 1917, 10 in 1918, and 7 in 1919. I have not included cases in which less than a year has elapsed since operation. Among these were cases of all degrees of severity. All were chronic cases requiring operative treatment in the opinion of competent ophthalmologists. Nearly all had gone through the usual treatment, such as probing, dilating, or slitting of the canaliculi. Several came to operation with fistulæ into the sac discharging pus over the face. All of the cases were relieved of suppuration or accumulation of fluid in the sac and all have remained well. Six of the fifty-five could not be followed longer than a year after operation but were well when last seen. Three had a little tearing after the operation but in these cases the canaliculi were very defective.

Two cases are of special interest. Each had had the sac removed on one side with an excellent result as far as suppuration was concerned but tearing was a disagreeable feature. Intranasal operation was done on the other eye in each of these patients for chronic dacryocystitis. The results were good and both patients said they very much preferred the second operation on account of there being no tearing.

I have observed no case in which there has been a complete closure of the opening though six have required treatment with punch or cautery after the operation on account of partial closure by granulations. All of these obtained good results in the end.

CONCLUSIONS.

The results of the operation are ideal if the opening is made large with smooth edges and treatment carefully carried out to prevent excessive granulation till healing is complete.

Suppuration is invariably relieved.

There is no tearing if the canaliculi are even in fairly good condition.

It is much better not to slit the canaliculi.

The worst thing that could happen after operation would be the closure of the opening. Even then either a secondary intranasal operation or an external operation could be done.

Considering the structures involved in the operation it is difficult to see how a serious complication could arise.

I wish to express my thanks to Dr. Brown Pusey not only on account of his having referred many of these cases to me but also for his kindly advice and encouragement.

BILATERAL GLIOMA. REPORT OF A CASE UNSUCCESSFULLY TREATED WITH RADIUM.[1]

By Dr. ARNOLD KNAPP, New York.

THE occurrence of glioma in both eyes, estimated at 20% of the cases, is regarded as the localization of a primary tumor in the two eyes; *i. e.*, the growth in the second eye is not an extension from the first. In this bilateral localization the condition is usually observed in the early years, in 94% of the cases the patients were under four years. The involvement of the second eye is generally noted at the same time with that in the first eye, but the growth is less advanced. Occasionally the growth in the second eye is observed some time later; in a few cases long intervals elapsed between the enucleation of the first and the affection of the second eye. It is possible that the condition in the second eye has been overlooked, or as Leber says, the beginning may be microscopic and hence escape even careful ophthalmoscopic examination.

Always congenital the tumor at first passes through a stage of very slow growth when it may be quite latent and it is only the late stages which show a rapid growth and cause symptoms.

Length of interval between the Involvement of the two eyes. A number of cases are on record where the interval between the involvement of the first and second eye was three and four years.

Thus Vetsch[2] reported a case in which the interval was three years between the onset in the first and the second eye. Von Grollman[3] observed a case with 4 years' interval. Treacher

[1] Read at meeting of American Ophthalmological Society, 1920.

[2] *Archiv. f. Augenheilkunde*, vol. xi., p. 413.

[3] *Graefe's Archiv.*, vol. xxxiii., No. 2, p. 47.

Collins[1] observed a case with an interval of three years. In the discussion of this case Lawford,[2] referred to a case in which a growth was observed in the second eye of a child whose eye was removed for glioma two years previously. Enucleation was refused, vision gradually deteriorated, and three years later the eye was hard, blind, and a yellow reflex was noted. The slowness (3 years) of the growth in the second eye is of interest.

In the case which furnishes the subject of this paper the interval of time before the involvement of the second eye became noticeable was four and one-half years.

Maghy[3] reported a case of bilateral glioma of the retina in which the second eye became affected thirteen years after the first. The first eye was removed for glioma in 1900, the patient being then two. In 1913 vision began to fail in the remaining eye, thirteen years after the enucleation of the first eye. The diagnosis was obscure and treatment was without avail. The eye was finally excised because of pain in 1918. Microscopically glioma retinæ was found present.

Glioma always undergoes regressive changes, ending in necrosis with fatty and calcareous degeneration of the necrotic tissue. The necrotic parts are the opaque white dots and streaks, while the young tissue is gray or grayish pink and translucent. The fatty parts soften into an amorphous fluid, with granules (calcification), hyperæmia of the vessels and hemorrhages.

Retrogressive changes with preservation of sight. Retrogressive changes may occur in eyes which still can see, and a spontaneous recovery of retinal glioma is possible. Glioma of the retina particularly when affecting the second eye may show a varying degree of malignancy.

Meller[4] reported on a case of true glioma retinæ in a second eye in which there was no progress in the tumor growth for five years, and in fact in the latter part definite signs of retrogression were present. This eye in 1910, presented a yellowish mass about 6 P. D. below the disk and extended, several P. D.

[1] *T.O.S.*, 1896, vol. xvi., p. 142.
[2] *T.O.S.*, 1896, vol. xvi., p. 148.
[3] *British Journal of Ophthalmology*, Aug., 1919.
[4] *Centralblatt f. Prakt. Augenhlk.*, vol. xxxvii., 9, 101.

broad, to the periphery for about 3 P. D. This mass projected into the vitreous with several tortuous and dilated vessels. A second yellowish white mass was present beyond. A third growth appeared in the extreme outer periphery. The disk was peculiar in that the vessels downward were thickened and tortuous. These masses somewhat enlarged in 1911, remained stationary in 1912, and the case was not seen again until 1915 when the vision was found to be normal, disk and vessels normal; the tumor mass was still present but flattened resembling choroidal atrophic areas except that it contained white calcareous-like masses. The smaller mass contained these white areas surrounded by a dark gray pigmented zone. The many thick and tortuous vessels on these masses had disappeared. The enucleated eye showed a typical glioma retinæ.

Purtscher[1] speaks of two members of a glioma family, one a boy of 5 and a woman of 29, who presented a peculiar picture of choroidal changes which was regarded at the Fuchs Clinic as undoubtedly retrogressive glioma.

Siegrist[2] reported with ophthalmoscopic drawing a retrogressive glioma in the second affected eye of a child of three and one-half where a grayish area occupied the macular region with a prominent white, glistening central lobular mass. Seven years later,[3] the white mass above and to the outer side of the macula was the same, and the individual figures were somewhat more sharply defined. The disk and the macula seemed perfectly normal. In the periphery, up and in, there still remained a diffuse, greenish, white area. The vision was $\frac{6}{9}$.

The ophthalmoscopic picture in these cases in regressive glioma is quite unusual. The changes usually occur about the optic nerve and macula at the posterior pole and consist in irregular choroidal atrophic areas with flat detachment of the retina by peculiar whitish masses and abnormal vessels.

Much more frequent is complete necrosis of the gliomatous tumor and shrinkage of the eye.

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[1] *C. f. P. A.*, vol. xxxix., p. 198.

[2] *Bericht d. Ophth. Gesell. Heidelberg*, p. 355, 1912.

[3] *Bericht. d. Ophth. Gesellsch.*, p. 317, 1919.

Retrogressive changes with shrinkage of eyeball, rarely with preservation of life. Temporary retrogression in glioma has been frequently observed; generally growth sets in again and progresses, leading to perforation of the eyeball and death.

Occasionally the eye affected with glioma shrinks; according to Leber, the shrinkage is not due to the regression of the glioma but is caused by an intermediary plastic uveitis which then ends in phthisis bulbi. The cases in which this occurs and no living glioma cells remain are unusual.

Parsons[1] reported on a case of glioma retinæ in a shrunken globe. The shrunken eyeball contained necrotic cells resembling cells in the degenerate parts of glioma. The blindness of the eye dates from an attack of measles at the age of eight months, or eighteen months before the child came under observation. He succeeded in collecting fourteen cases of glioma retinæ associated with shrunken globe. In ten of these the other eye was the seat of the glioma. The shrinking occurred after perforation, the result of extra-ocular extension of the growth, and in others, inflammatory symptoms preceded the phthisis bulbi.

Berrisford[2] found 20 cases of gliomata in shrunken eyes recorded in literature and published one case.

O'Connor[3] reported a case of glioma and phthisis bulbi in the first eye and glioma with orbital extension in the second eye. Verhoeff who made the microscopic examination of the first eye regards the glioma as primary and the phthisis bulbi as following an inflammatory reaction about the necrotic tumor.

Knieper[4] reported on a case where shrinkage of an eye following glioma retinæ was under observation for a period of eleven years. This author has collected all previous publications of phthisis bulbi in retinal glioma. Her own case was that of a bilateral glioma in whom one eye was enucleated and removal of the second eye was not permitted. Eleven years later the child was accidentally found in a blind asylum and a very small phthisical eyeball discovered. In the meanwhile, the eye had first enlarged, then suddenly perforated and col-

[1] *O. H. R.*, vol. xvi., p. 141. [2] *O. H. R.*, vol. xx., p. 11.
[3] ARCH. OPHTH., p. 312, 1917. [4] *Graefe's Archiv.*, vol. lxxviii., p. 310.

lapsed. Knieper reviewed twenty-two cases found in the literature and found in the majority that the observation period of the shrinkage was too short, and in these the possibility of a subsequent growth could not be excluded. Wadsworth's observation is quoted in this connection where after phthisis bulbi had existed for 20 months glioma again progressed.

deKleijn[1] observed a case of bilateral glioma in whom the secondarily affected eye without inflammation gradually became smaller and blind. The eye was removed and contained calcareous and bony tissue and gliomatous material.

Lindenfeld[2] reported on a case of a child, four years old, with glioma in the right eye and atrophy of the left eye. The left eye at first became enlarged, red, and painful. This was abruptly followed by shrinking of the eye and pain ceased, and the eye remained small for two years without any change. The right eye enlarged and extraorbital growth occurred. Both eyes were enucleated and the shrunken eyeball showed a connective tissue mass with calcareous deposits, bone formation and no traces of living glioma cells. This case shows "spontaneous cure" by complete necrosis of the tumor and shrinkage of the eye.

The *history of the case* which is the subject of this paper is as follows:

W. D., aged 6½ years was seen on April 28, 1919, with a history that at the age of two the left eye was removed for glioma by Dr. George W. Swift of Seattle, November 4, 1914. About four months ago the sight in the good eye seemed to be defective, and a diagnosis of glioma was made by Dr. Swift.

The boy is well nourished, fully developed, and has apparently enjoyed good health excepting at the age of six months there was some fever while teething. He has never suffered from enlarged glands.

Examination showed absence of the left eye. The orbital cavity was normal.

Right eye: Vision $\frac{6}{12}$. The anterior segment of the eye was normal. Tension normal.

After dilating the pupil a few vitreous opacities were

[1] *Graefe's Archiv.*, vol. lxxx., p. 371.

[2] *Graefe's Archiv.*, vol. lxxxvi., p. 141.

found present. The disk could not be made out, being hidden by a round subretinal mass directly above and the retinal vessels passed forward over the swelling. The mass was distinctly pink with several round, white areas. Its elevation was 6 D. Below this there was a whitish area like organized tissue which projected into the vitreous. Vessels ran along its sides, and as it extended down it broke up in two directions, one temporarily to join a series of retinal hemorrhages, and the other nasally was prolonged into a number of intensely white, rounded, vitreous bodies, directly continuous with a large white mass which occupied the extreme nasal periphery of the eye ground. This extended as far upward as can be followed. It was of an intensely white, fluffy appearance without detail, except at its upper margin where there was another pink subretinal mass surrounded by a number of hemorrhages. The ophthalmoscopic picture was regarded as typical of glioma, particularly on account of the large white vitreous bodies.

The boy was taken into the hospital and as there was no fever a general tuberculin test was instituted without any reaction either local or general.

During this period the changes in the eye ground showed distinct progress, and on May 13th the vision was reduced to $\frac{6}{18}$. There were more vitreous bodies. The subretinal mass which was regarded as active, seemed distinctly enlarged and to have become more distended.

It was decided to immediately begin treatment with radium, and at the General Memorial Hospital under the direction of Dr. H. H. Janeway and Dr. Douglas Quick on May 12th an application of radium was made: 414*mc* of radium filtered by *2mm* of lead and $\frac{1}{2}$*mm* of silver was applied for 5 hours at a distance of *2cm* from the skin over the right temple.

May 23d: Vision $\frac{6}{24}$. The pink mass was much clearer. There was perhaps more blurring in the part below.

May 31st: Vision the same. The pink mass continued to clear up. The skin of the eyelids showed some reaction from the treatment.

June 10th: Decidedly clearer. The hemorrhages in the vitreous and the glioma flocculi have disappeared. There were still some vitreous opacities, but they were less dense.

The improvement kept up for nearly six weeks, then on June 23d, the active and pink area directly above the disk again enlarged and became swollen. Its upper margin was more blurred. Another treatment of radium was decided upon: 168*mc* with the same filtration at a distance of $2\frac{1}{2}$*cm* was applied for 15 hours.

July 18th: Vision $\frac{6}{60}$. The general appearance was quite changed. The picture was very muddy, and the vitreous appeared stirred up. The white patches have gone; the pink area was less swollen. There seemed to be a number of fresh hemorrhages, and a possibly new detachment directly down.

July 28th: The pink mass to-day was distinctly yellow. The vitreous blurr continued and some degenerated gliomatous masses were present. The large mass in the nasal periphery showed some fresh hemorrhages and cholesterin deposits.

July 31st a third radium application was made: 1312*mc* with the same filtration but covering a larger area was applied at the side of the orbit at a distance of 3*cm* for $2\frac{1}{2}$ hours.

October 6th: Vision $\frac{3}{60}$. General condition good. The pink area was distinctly enlarged. It was now white and there were no pink areas to be seen.

October 6, 1919, fourth radium treatment: 1227*mc* in a smaller type of container but with the same filtration, at a distance of 3*cm* was applied at the side of the orbit for 2 hours.

October 21st: The last treatment was followed by a very distinct failing of vision. The mass had manifestly enlarged being seen with a plus 8 D. It occupied the center extending down and nasally. The fundus was very much more blurred and the details were difficult to decipher.

November 4th: The mother reported that his sight was at first very poor but has perhaps recently improved — $\frac{1}{60}$. The grayish mass occupied the center extending down. The nasal periphery was muddy. There were no fresh hemorrhages. The mass appeared gray and white with definite degenerative areas. Vitreous opacities as before.

As Dr. Janeway did not advise any further treatment with radium the boy returned to his home in the West.

A letter from his mother received December 20th stated that his sight was very much worse. He cannot see the fingers at any distance. In the opinion of the mother while the sight had usually improved with each radium treatment, it failed to do so after the last.

In a letter recently received the mother stated that the sight was entirely lost and the eye was subsequently enucleated.

The Early Ophthalmoscopic Signs of Glioma Retinæ.

The early ophthalmoscopic symptoms of glioma retinæ are not fully described. Now that the importance has been

brought out of examining the second eye with dilated pupil and in narcosis if necessary, our knowledge of the early stages should be amplified. In those descriptions that are on record there was found in the retinæ a sharply-defined, opaque, grayish white area, which is distinctly prominent and sometimes constricted at its base. The surface may present several flat depressions. Its form is round or oval; its size varies from ½ to 4 P. D. It arises at the disk or in the region of the macula, or at some distance away. Sometimes there are two distinct tumors. One author observed at the posterior pole a number of white nodular elevations surrounded by pigment. A larger mass has been observed surrounded by a number of small nodes. Vessels continue over the tumor, branch and disappear in its substance, then again to reappear. In other cases there are no sharply defined tumors, though there is a general prominence suggestive of a beginning detachment of the retina. Even in these early stages the cases show a tendency to divide into two groups, as a detachment of the retina is present or absent. If there is no detachment, a white glistening, nodular or clefted mass is seen, or more anterior there is a pale white flat reflex or tumor mass. The vitreous contains white flocculent bodies of various size which slowly float and represent miliary tumor-nodules;—these are very prone to absorb or to degenerate. The process apparently can be either in front or back of the retina. There is a distinct difference in the appearance as the growth retrogresses or advances. In the latter stage it is pink, while in the former it is white. Hemorrhages are not infrequent.

In the case just described the opthalmoscopic changes can be divided into those which are subretinal, rounded in outline, and pink in color denoting activity in growth. The other changes are in front of the retina and include the retina itself; these are white, like organized retinal connective-tissue, with organized whitish masses and intensely white areas, necrotic in character. The vessels do not show any particular variation. Hemorrhages occur both in the retina and in the vitreous. A very striking and characteristic picture are the intensely white gliomatous flocculi in the vitreous. The ophthalmoscopic picture is characteristic and quite different from those seen in tuberculous retinitis and exudative retinitis.

RESULTS OF RADIUM TREATMENT.

A number of cases of glioma retinæ have been treated with radium. The first and perhaps the best known because the treatment seemed successful at first, is the case which Axenfeld[1] reported two years ago. The case was treated with X-rays, and had been under observation for two and one-quarter years. The three nodules were reduced to small spots. At first no other change occurred in the eye. Then a cataract developed which was successfully operated upon, with restoration of vision. A discission was done a half year later. The gap in the membrane contained numerous white flocculi in the vitreous body. A detachment of the retina then developed; a partial detachment in the region of the macula had occurred during the process of the treatment. The present detachment, however, extended, and it was not until some time later that the child came back with a large perforating ulcer of the cornea, prolapse of iris, and the eye was enucleated.[2] On examination, a relapse of the glioma was found particularly in the retina, in the form of small groups of cells. These cells showed a uniform sarcomatous character as is seen in choroidal and orbital extension.

Axenfeld cautions that the prognosis should be guarded, and that a number of years must elapse before a final decision can be given.

A number of cases treated with radium have been reported in this country. Dr. H. H. Janeway[3] at the General Memorial Hospital has treated six, of which only one (Schoenberg's case) has done well. Schoenberg's case[4] was that of a child of 5 whose second eye was treated by radium and X-ray, with recession and arrest of the tumor and preservation of good vision during a period of observation now of three years. An opacity at the posterior pole of the lens developed in the course of the radium treatment. About the regressive gliomatous tumor a ring of chorio-retinitis developed which Schoenberg suggests as resulting from the radium therapy. Similar

[1] *Kl. Monatsbl. f. Augenhl.*, vol. liii. and liv.
[2] *Axenfeld, Deutsch. Ophth. Gesellsch.*, Heidelberg, 1919.
[3] ARCH. OPHTH., p. 163, 1920.
[4] ARCH. OPHTH., p. 485, 1919.

changes have, however, been observed in cases of spontaneous regressive changes (Meller's case).

The authorities are in accord in regarding the structure of gliomatous tumors as being particularly susceptible to radioactivity. On the other hand experience has shown that the best results in the treatment of cancer are obtained by the use of a single large dose. In the case described in this paper distinct improvement followed the first treatment. Our ill success in glioma seems to be due to the fact that not a large enough dose of radium was given to kill off the gliomatous tissue. The associated injury to other tissue of the eye (cataract) is negligible. In judging the results with radium the varying malignancy of glioma must not be forgotten and a certain, if not extremely rare, possibility of spontaneous retrogression.

NASO-LACRIMAL SURGERY IN OPHTHALMOLOGICAL PERSPECTIVE.[1]

By Dr. CLIFFORD B. WALKER, Springfield, Mass.

(With three illustrations on Text-Plate XX.)

IN the last decade, considerable progress has been made in the surgery of the lacrimal apparatus, especially in the development of naso-lacrimal fistula operations, but it is still questionable whether as much advance has been attained as is possible because of the fact that the region which needs the most study happens to lie in the plane of cleavage, as it were, between the domain of the ophthalmologist and the rhinologist. Thus the region corresponds in a way to no man's land, as far as naso-lacrimal fistula is concerned.

Furthermore, other factors are also active in preventing fruition of the fullest possible knowledge of the ultimate possibilities of naso-lacrimal fistula. For instance, the patient almost invariably presents himself to the ophthalmologist, since the visible manifestations of the condition are almost entirely ocular, but the ophthalmologist is reluctant to exploit procedures that lead him into a strange field, and as a rule, the patient is reluctant to pass out of the hands of the ophthalmologist for treatment. This feeling may be mutual. The rhinologist while he is more prone to consider and perform naso-lacrimal fistula operations, may not be familiar with the passage of probes in the lacrimal apparatus, and since he does not have many cases to deal with perhaps in this connection, does not advance his knowledge and technic with the same persistence that he does in other portions of his field.

[1] Read at meeting of American Ophthalmological Society, June, 1920.

And thus, from a statistical standpoint the exact possibilities of the operation remain to be seen. Certainly at the present time it is usually possible to get a sharp argument from ophthalmologists as to whether naso-lacrimal fistula operation has any advantage whatever over extirpation of the sac, in fact it seems to me that the majority of ophthalmologists contend that since extirpation of the sac cures such a high percentage of cases, or makes them so comfortable, that there is no use in considering any other operation. I remember a similar plea for iridectomy, as against the trephine operation for glaucoma, at the time this operation was introduced by Elliot, but at this point the analogy cannot be carried farther since after the visit of Elliot to this country there was a flood of test operations that gave us very substantial data on which to make comparisons, while following the introduction by West, of the possibilities of naso-lacrimal fistula some ten years ago, the report of test cases has been comparatively meager.

The variety of operations that have been suggested is a testimonial that we are still in the formative stage as far as the ideal procedure is concerned. Yet even now the data, slow as they have been in accumulating, are sufficiently crystallized to indicate that eventually a naso-lacrimal fistula procedure will become the operation of election, for a definite group of cases, and set aside the great many lacrimal-sac extirpations. I expect this result to be brought about more by the demand of human nature than by any other single factor, for I have yet to see the patient who would permit an external incision to be made, with its scarifying possibilities, if the same result could be obtained without an external incision, provided only that the patient may be assured that the procedure will be painless; and this assurance can be given. Unquestionably we have all seen patients suffering with chronic dacryocystitis who have undergone a variety of local treatments and even a most painful series of probing unsuccessfully, and even after ten or fifteen years still unwilling to permit an external lacrimal sac extirpation. Yet these very patients may be delighted indeed to have the naso-lacrimal fistula operation done as soon as they are assured that it will not require ether, and can be done without pain.

While this factor may readily be the predominant element

in turning the tide it is not clear to me that there is not some sophistry prevalent concerning the mechanism of improvement with sac extirpation, particularly concerning some magic or trophic influence of the lacrimal sac over the secretory lacrimal mechanism. In fact I believe as the possibilities of naso-lacrimal fistula operation are developed it will prove that only in rare instances will the results of sac extirpation be superior in subsequent functional result to that of the successful naso-lacrimal fistula, but first we shall have to find by experience just what conditions contraindicate the fistula operation.

The principle of fistulization is no different here than in other regions of the head. The natural tendency is for a fistula to close, unless it is kept open by a continuous pressure of fluid, an abnormal growth of cells, by plastic reconstruction, or by a gap in the tissues too great to be bridged by proliferation or granulations. In the case of the naso-lacrimal fistula we are aided to some extent by the pressure of drainage through it, but principally we must depend on making the largest possible opening or by a plastic-flap operation, but plastic-flap operation involves an external incision to be at all reliable, and therefore will doubtless be abandoned.

The ability of a fistula to resist closure is usually measured by its narrowest diameter. The shortest diameter in the naso-lacrimal fistula is more or less equal to the diameter of the sac and its bony canal antero-posteriorly. Vertically a much greater diameter may be obtained, but it will not prevent closure if the antero-posterior diameter of the opening is left too short, and there is a tendency for this to occur in the nasal operation because of the anatomical relation; the direction of approach being such that it is much easier to get a sort of oval opening with the long diameter parallel to the canal. This difficulty accounts for some of the failures in this technic and of course it should be carefully avoided. The best way that I have found to avoid this narrowing tendency of the antero-posterior diameter is to use a burr, Fig. C, on the bony opening, thereby obtaining a smooth round opening of sufficient diameter. The burr is spherical in shape and seven millimeters in diameter and may be either hand- or motor-driven. It may be used with or without a guard.

Although the desire and attempt to produce a naso-lacrimal fistula extends back almost as far as the history of medicine, it cannot be said that any material progress was made until the work of Toti. Before his time efforts had been mostly directed towards punch opening from the sac into the nose, or the dilation by means of probes and subsequent use of stylets. As is often the case in developmental work, the original operation is, not uncommonly, too elaborate, and it was not long before Halle, West, and others showed that an external incision was not absolutely necessary nor were the plastic procedures of Toti necessary for the successful maintenance of a fistula in a high percentage of cases. And it still remains to be proven whether plastic operation has any material advantage over the simple, circular opening of maximum diameter.

To the knowledge that a fistula opening could be maintained Halle added the valuable technical trick of forcing the nasally exposed surface of the sac far enough into the nose, by means of a probe passed through the uncut punctum, so that a round window could be comfortably cut in this side of the sac to correspond to its largest possible diameter. Add to these important steps the knowledge that a very perfect anæsthesia may be obtained without toxic manifestations by applying a small amount of cocaine mud to the nasal wall opposite the sphenopalatine ganglion at the posterior tip of the middle turbinate, and another small portion to the nasal wall, at the anterior extremity of the cribriform plate, and the field is open for an accumulation of facts concerning the possibilities of this operative procedure.

At the time Toti was doing his work and immediately thereafter we find report of operations showing forty to fifty per cent. perfect results and fifteen to twenty per cent. showing improvement. As time goes on the percentage of favorable results improves, and the percentage of failures decreases, until among recent reports, Patterson, Fraser, Wiener, Sauer, and others, we find eighty per cent. of perfect results and only ten or twelve per cent. of failures, with other cases no better or no worse than the ordinary sac operation, and it does not seem unreasonable to hope that as more reports are submitted and more careful studies made of failures, that very much

better percentages may be obtained as we become able to make more accurate and satisfactory selection of cases.

The cases of dacryocystitis naturally fall into two groups, acute and chronic. My first cases were limited to the acute type and were handled in a purely ophthalmological manner. They were all the ordinary phlegmontype, with the eye almost closed, and the swelling most marked in the region of the inner canthus. Since an external incision was deemed necessary because of the extent of the phlegmon it was made as for a sac extirpation but it was determined to exploit the possibilities of the internasal drainage of the abscess by the fistulization process. Hugging the nasal side carefully the dissection was carried down between the sac and its nasal wall; a very narrow mastoid gouge or chisel was then used to make the initial opening through the nasal wall as far anteriorly as possible. The chisel tip may be easily seen as it enters the nasal cavity directly in front of the middle turbinate. There is no important structure to be injured by the chisel as it is pushed horizontally inward. The agar nasi cell may be well-developed and overlie the sac so that it has to be traversed by the chisel, but nevertheless the opening is enlarged sufficiently to allow the entrance of a sphenoidal or a Kerrison punch. A burr may also be used. The bony opening is then enlarged in all directions to correspond to the maximum horizontal diameter of the canal. Without doubt a much more accurate and satisfactory opening can be obtained in this way than it can by means of the internasal work.

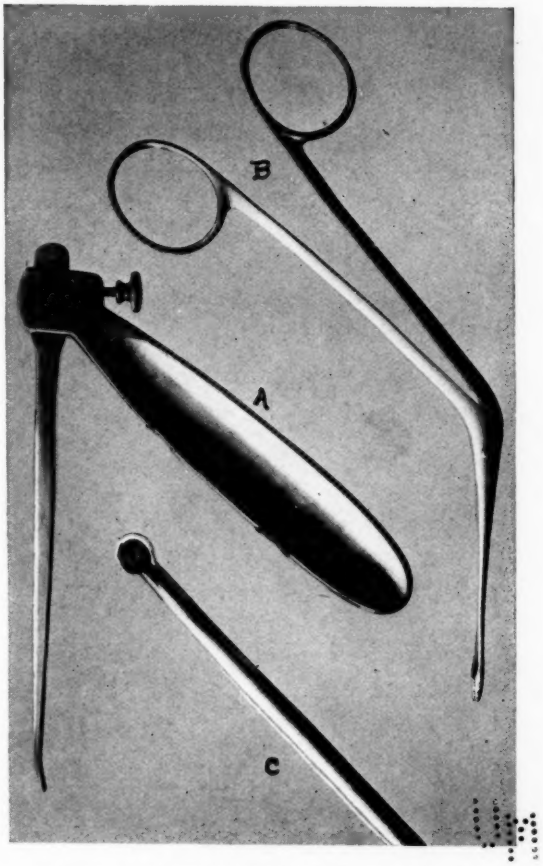
In most of these acute cases some pus is apt to be found in the agar nasi cell, or in the anterior ethmoid cells, at the time the nasal opening is made. After the nasal opening is made the punctum is dilated and a probe passed into the sac, and that portion of the sac is located which corresponds to the central portion of the bony opening already made. If the sac has ruptured of course a good deal of pus will have been encountered and drained before the sac is opened, and still more pus is evacuated from the sac when the window is taken off, which corresponds with the bony opening. A good-sized probe should now pass freely from the punctum through the sac and into the nose. In order to maintain these openings and insure drainage, as well as satisfactory apposition of layers,

a small gutta-puercha (protective) cigarette drain of satisfactory size was pushed through the nasal opening and made to extend an inch or so into the cavity. The other end of the cigarette drain was split and rolled into two small balls, one of which was tucked into the dome of the lacrimal sac, and the other portion pushed downward into the canal. The external wound was then closed and no further dressing made. In four or five days the cigarette drain was pulled forward through the lower nares and the patient was watched for several weeks to see that granulations did not close the fistula. It happened that in none of these cases was there any marked catarrhal condition of the nose and the opening showed no tendency to close. I can recommend this method also for chronic cases where an external incision will be permitted.

Reports as long as two years in duration show that these cases have been in good condition without recurrence since. The chronic group of cases which I have operated upon includes conditions varying from six months' to twenty years' duration. The method used embodies the fundamental principles as laid down by Halle of uncapping the lacrimal sac immediately in front of the anterior attachment of the middle turbinate, then pushing the sac into the nasal chamber by means of a probe pushed through the uncut punctum, and excising much of the tent, thus produced, as can be obtained.

Certain difficulty encountered in accomplishing these maneuvers and the instruments used may be here described. One of the first difficulties that I encountered was in getting a chisel to bite into the bone at the proper distance in front of the middle turbinate; it is a good time here to make the chisel slip into the upper prolongation of the maxillary bone, and yet in many cases the chisel comes so nearly parallel to the bone that it slips off readily. Accordingly I had a chisel, Fig. A, hollow ground on the back and beveled to about the curve of a finger nail so that it would readily bite into the bone even if it was held very nearly parallel to the bone. A handle was then devised so that it could be held with the hand braced against the cheek in such a manner that the chisel was held in proper position and at the same time prevented from overacting or going too deeply. The removal of the bony window is very easy with this chisel but it is still easier with the burr shown in

ILLUSTRATING DR. WALKER'S ARTICLE ON "NASO-LACRIMAL SURGERY IN OPHTHALMOLOGICAL PERSPECTIVE."



A. Reversible handled chisel used to uncap bony wall of lacrimal sac.

B. Modified Hartman forceps used to grasp sac only while tented by probe.

C. Burr with guard.

the illustration which has a guard to prevent injury to the nasal septum. However, all hospitals do not have the necessary motor for driving such an instrument, so that it is advisable to have a chisel also, but when the sac is already exposed the opening can be very easily enlarged with the burr, even used in the hand without a motor.

At this stage it is easy enough to tent the sac into the nares, but it is sometimes difficult to get a good-sized hold of it, in order to excise the window, since the instrument with which the sac is grasped is so apt to include also the probe, and each time the probe is withdrawn the grasp on the sac either lost or weakened. A few serrations were filed out of the grasping portion of an ordinary Hartman forceps, Fig. B, so that a No. 1 or 2 Bowman probe could just barely pass through this interstice without being held when the forceps was closed. Now when the probe is in the sac the tented portion is grasped including the probe; there is no difficulty experienced in removing the probe from the grasp of the forceps, and leaving the sac without disturbing the hold on the sac itself. However, this grasp on the sac may be still further improved by inserting another forcep and grasping the sac still closer to the ocular side. To cut out the window of the sac thus held I have used an ordinary cataract knife satisfactorily, though without a doubt a small blade curved on the flap, about one-half inch long, would be the most satisfactory. After cutting out as much of a window as is possible in this manner it is often possible by working the probe around to tent a part of the lip on one edge or the other and remove by the same steps still more of the lateral margin of the window.

In the chronic group of relatively short duration, six months to two or three years, and with very little nasal catarrh the results obtained are practically perfect. The sac wall is not hypertrophied or thickened and the healing process is almost as prompt and satisfactory as that obtained in acute cases, but the most interesting cases and those demanding the most study are of long duration, ten to twenty years, and have often been through many previous procedures without relief. Chronic catarrh is apt to complicate these cases and chronic or subacute ethmoiditis and catarrhal deafness may also be present. It is in this group I think that failures are more

likely to occur, but perhaps with further study we may be able to determine just which cases are very apt to fail, and avoid operating upon them internasally. Two cases in this group it would seem profitable to discuss in more detail.

Mrs. J. B. C., age 52, has had chronic nasopharyngeal catarrh for the last twenty-five years, during the last twenty years her hearing has progressively failed until at present she can only hear the loud spoken voice. For the last twenty years she has had chronic dacryocystitis on the left but no trouble with the right eye. She has been treated extensively by many physicians but no improvement has been made. For the sac condition innumerable probings and irrigations have been carried out, and one difficult operation under ether, probably a probing and the placing of a style, resulting in a very severe reaction which did not quiet down for several weeks. For the last ten years the eye has been slightly reddened under irritating influences of the chronic discharge from the sac and constant wiping of the eye. At present the eye is decidedly inflamed and pus can be readily expressed from sac.

On preliminary treatment March 22, 1920, a large quanity of pus was irrigated from the sac through the lower punctum, but it was impossible to force any fluid into the nose, though a probe could be readily carried to the nasal wall of the sac. On March 26, 1920, she was operated on in the manner described internasally, and apparently a very satisfactory opening was obtained. As is usual in these cases the first night was very painful, and there was a moderate amount of bleeding (I have not found it necessary to use packing), but the next day she was comfortable. On the second day no difference in appearance could be seen in the two eyes, and the patient was overjoyed at the result of the operation. She lived a considerable distance out of town, however, and it was difficult indeed for her to come in for follow-up treatment. Fluids passed readily and there was no indication of difficulty until on April 24, 1920, it was noticed that granulations were not subsiding rapidly enough in the neighborhood of the operation, and there was more resistance to fluid syringed from the punctum into the nose through the opening. Trichloracetic acid, and strong silver-nitrate solutions were used to reduce granulations, but on May 13, 1920, it was noted that the granulations had a very firm and proliferating tendency. A bunch formed about the opening very similar to a keloid in appearance. Fluid can still be forced into the nose, but a probe will pass with difficulty there is evidently sufficient drainage so that the

patient experiences no difficulty. The eye is still without inflammation or epiphora.

While from the patient's standpoint this operation is still a success it seems to me that it must eventually turn out to be a failure, though I expect to attempt another operation, but the manner in which these chronic catarrhal membranes form scar tissue of elevated character, much as one sees in keloid on the skin, seems to put this case in an entirely different classification from the others I have operated upon. It is possible that the antero-posterior measurement of the opening was not as wide as possible, and on this I shall attempt another operation. On the other hand, the proliferating characteristics of the scar tissue granulation formation after the operation suggest that it may be able to bridge any opening of width that is possible. If this case turns out to be a failure it will be the only one that has occurred in a group of ten so far. To observe the formation of scar tissue and granulations in detail the small nasopharyngoscope with corrected image is very satisfactory indeed.

The following case is very similar in many respects, except that the tendency to exaggerated granulations and scar tissue formation has not been noticed with the nasopharyngoscope at all.

Mr. E. B., age 60, presented himself on March 27, 1920, for catarrhal treatment. He had chronic dacryocystitis of the right eye, of twenty years' duration, and had been through many operations and probings of the most painful type. The canaliculus of this eye had been slit and stylets had been inserted, but all to no avail. The left eye had been bothering the same way for the last two or three years increasingly. Deafness of catarrhal nature had also been approaching for the last ten years, but had not become much of a handicap until the last five years. Now he can only hear the loud spoken voice. He is constantly wiping his eyes all day long in order to see clearly. Pus was syringed in copious quanities out of both sacs but no fluid could be made to pass through into the nose. The lacrimal probe could be readily passed to the nasal wall of the sac on both sides.

On April 25, 1920, the naso-lacrimal fistula operation was done internasally on the left side, and a well-defined

ethmoiditis of the anterior cells was drained at the same time. The operative area has healed kindly with no marked tendency to hypergranulate, and the eye has been clear since the day after the operation. A silver nitrate bead was used to cauterize the few granulations that were active May 6, 1920.

May 6, 1920, the naso-lacrimal fistula operation was done on the right side internasally, here also a mild ethmoiditis was drained, and the sac itself was found to be markedly hypertrophied, the walls being about one-eighth inch in thickness. However, the granulating tendencies were not present here, as seen in the previous case, and so far the opening has maintained itself in excellent condition. A chromic acid bead has been used to cauterize the margin of the wound on this side.

It may be worth while in passing to mention here a trick in cauterizing the wound margin for granulating conditions in these cases. A fine wire such as one may get with syringe needles was bent to form a narrow figure of eight, five millimeters in length, on the central portion of this, a little bead of molten silver nitrate or chromic acid was dropped and formed symetrically, leaving a loop of wire projecting at either end. A silk thread was then passed through these wire loops and knotted, so that the bead could not slip along the course of the thread. About eight inches of thread extended from one loop and ten inches from the other, with the bead centrally situated. The long end of the thread was passed through the eye of a slender needle and the eye of the needle carrying the thread was passed through the punctum in the same manner as a probe would be passed, as far as the septum, and then slightly withdrawn so that the loop of thread was readily caught on a small hook, and the needle was withdrawn from the punctum. This left a loop of the long end of the thread in the nose. This loop of thread was then gradually worked down until it projected from the lower nares. The other or short end of thread was passed through this loop. The loop was then drawn upward through the punctum dragging with it the short end which was finally left protruding alone through the punctum. Then by drawing this end through the punctum, the bead is drawn into the nose and accurately to the margins of the wound from the nasal side.

In the presence of swelling, and with the septum very close to the operative wound, the operative channel can be better cauterized by using the bead this way than when the bead is simply annealed on to the end of a bent wire and applied at the margin of the wound. The bead is made to travel up the blade of a nasal speculum, so that it does not unnecessarily cauterize neighboring parts of the nose.

Comment. From an observation of the process of healing as seen through the small nasopharyngoscope, it does not seem clear that the flap operation would necessarily add much toward the preservation of a fistula in these cases, in the first place because it is almost impossible to arrange flap properly in this awkward area, and in the second place the tremendous amount of swelling and the process of sloughing, which takes place immediately after the operation, because of the fact that it is not an aseptic operation, would without doubt tear all sutures from their anchorage and allow flaps to be displaced. Statistics also bear this view out because the proportion of failures is no less where plastic work has been done. In fact it is just as easy to assume that the operation is successful in spite of the flap and to assume that it is successful because of the flap. From an ophthalmological standpoint, of course, this observation is interesting and valuable because it makes the operation as feasible through an external incision as it does through an internal incision, since the only important point is an opening of sufficient size that it will not be bridged by granulation tissue in the group of cases where success in the operation may be expected. Doubtless in the group of cases in which the operation will not be successful flaps will be of no avail anyway, and we must simply learn to exclude those cases from the fistula operative procedure and resort to lacrimal sac extirpation.

While at present it seems possible that ten per cent. of failures may be expected from the naso-lacrimal fistula operation as far as we can prove from our present data, still it seems possible to me that if the ophthalmologist would take hold of this operation more frequently there would be other advantages derived besides development of the ability to eliminate the unfavorable cases and reduce the ten per cent. of failures to practically nil. One of the first advantages would be to

conserve a familiarity with the orbital wall of the nose and this familiarity would undoubtedly be helpful in other instances. Thus, only a short time ago, I saw a patient who had been repeatedly fitted for glasses in the last six months, by various men, for the relief of a peculiar discomfort between the eyes. His vision was excellent with all of his glasses and on looking into his nose it was obvious that his difficulty was due to sinus trouble since good-sized polyps were visible in the upper part of his nose. In the field of perimetry also a nasal examination may be helpful, for instance. I have seen pus about the middle turbinate to be decidedly important in the diagnosis between certain cases of glaucoma and ethmoidal sinusitis, or even a hypophyseal dystrophy where the visual defect was inclined to be sclomatous in character or more or less referred to the temporal portion of the field. This attitude does not necessitate that the ophthalmologist become a rhinologist, because he looks in the nose, any more than it seems that a rhinologist becomes an ophthalmologist because he looks in the eye, in fact I believe there are more rhinologists who are familiar with the use of the ophthalmoscope than there are ophthalmologists who are willing to use the nasal speculum and the head mirror.

CYCLOPIA, ITS BEARING UPON CERTAIN PROBLEMS OF TERATOGENESIS AND OF NORMAL EMBRYOLOGY; WITH A DESCRIPTION OF A CYCLOCEPHALIC MONSTER.[1]

By Dr. EMORY HILL, Richmond, Va.

(*With three illustrations on Text-Plate XXI.*)

I. Introduction.

This paper attempts (1) to present the newer conceptions of cyclopia which are not found in the literature of ophthalmology, and (2) to discuss certain questions of embryology suggested by the study of cyclopean eyes.

II. Historic Résumé.

Mythology; supernatural causation of monsters; natural causation of monsters; the theory of hybridity; the theory of maternal impressions; early experimental teratogenesis.

III. Modern Theories of Teratogenesis.

1. The Germinal Theory.
2. The Non-Germinal Theories.
   a. The Mechanical Theory.
   b. The Pathologic Theory.
   c. The Embryologic Theory.

IV. The Eye in Cyclopia.

V. Other Deformities Associated with Cyclopia.

VI. The Mechanism of Cyclopia.

VII. Description of the Author's Specimen.

VIII. Modern Experimental Teratogenesis.

Stockard's experiments with fish embryos.

[1] Candidate's Thesis, American Ophthalmological Society, 1920.

IX. The Classification of Cyclopia.
Adami's growing-point hypothesis.
X. Problems of Normal Embryology.
1. The Position of the Optic Anlage.
2. The Origin of the Optic Nerve.
3. The Self-differentiation of the Crystalline Lens.
XI. Conclusions.

I. INTRODUCTION.

Ophthalmic literature contains many references to cyclopean eyes and some rather comprehensive monographs treating of various phases of the subject of monstrous formation of the head end of the embryo. The most modern of these contributions, which are more than mere case reports, accept the observations of Dareste, and the later and exceedingly important investigations which go to disprove the earlier theories of the causation of cyclopia have not found their way into the literature of ophthalmology.

Camille Dareste (20), in his monumental work on the artificial production of monstrosities, concluded that cyclopia is the result of a premature closure of the anterior end of the neural tube, though he confessed his inability to explain why this premature closure should take place. His conclusions were recorded in full in the *Annales d'Oculistique* (19) in 1891. The life-long work of this devoted scientist stands as the high-water mark of experimental teratology at that time. Numerous later authors close their contributions with a review of Dareste's conclusions as the last word on the subject. Ballantyne (9), whose name is intimately associated with the literature of fetal pathology and teratology, dismissed the subject of cyclopia in 1905 with the acceptance of Dareste's theory. A perusal of the literature up to this date gives the impression that the question of cyclopia has been settled. Accurate and laborious experiment upon the chick embryo, however, did not solve the problem. The great respect which has been accorded to Dareste's work is not inconsistent with the belief that his deductions do not fit all cases, and do not constitute a generally acceptable explanation of cyclopia. It must be noted also that during the time when Dareste's ideas were accepted, the

germinal theory of the origin of monstrosities was still in vogue. In so far as cyclopia and many other monstrosities are concerned this theory has been disproven.

In view of the newer observations on embryologic pathology and experimental teratology, of the fact that every germ cell has in it the possibility of monstrous development, as Mall (63) has said, and the fact that changes in the chemical environment of the developing embryo can lead to cyclopia, it seems appropriate to review the subject and incorporate in the ophthalmic literature the present-day conception of monstrosities which present altered eyes.

Experimental embryologists, in attempting to explain cyclopia, have been led to investigate the earliest appearance of eye-forming material in the medullary plate, with the result that important information in regard to the median position of the optic anlage has been obtained. This information deserves a place in ophthalmic literature because it comes from a reliable source, and because it is contrary to the generally accepted view of the position of the eye anlagen.

It is instructive to observe the development of eyes which are abnormally placed and thus separated from contact with the adjacent structures to which they normally bear an intimate relationship. Thus, the integrity of the ganglion cell and nerve fiber layers of the retina in the cyclopean eye of anencephalic monsters bears upon the problem of the development of the optic nerve; and the absence of a lens in an eye which is deeply seated away from contact with the surface ectoderm, and the presence of lenses developed from ectoderm in the absence of an optic cup, concern the mooted question of the self-differentiation of the lens as opposed to its dependence upon the optic cup. Therefore, the degree of autonomy possessed by certain ocular structures may be studied in cyclopean monsters in which these structures are deprived of their usual associations.

II. HISTORIC RÉSUMÉ.

Mankind seems always to have been fascinated by the appearance of monstrosities. Cyclopia has had a large share in stimulating the imagination of the ancients and encouraging

both speculation and experimentation among more modern generations. Ballantyne (9), in his work on Antenatal Pathology, vol. ii., gives a picture of a Chaldean cuneiform tablet dating about 2000 B. C., with a descriptive list of monstrous births. Gravelotte (31), in the bibliography attached to his thesis in 1905, refers to the works of Homer and Hesiod in the ninth century B.C. The Greeks used the term Cyclops to describe several kinds of superman. It is a far cry from the unviable fetus with a median eye and deformed or absent brain to the giant Polyphemus and the forgers of the thunderbolts of Jove, yet the observation of nature seems to have given rise to mythologic creations. Schatz (94) suggests that the ancients deified those monstrosities which accorded best with their idea of what a god should be like, and that their ideal of beauty led the Greeks to take the least repulsive cyclops and transpose its proboscis from the forehead to the normal position and shape of a nose.

The importance attached to monstrosities in ancient Rome is indicated by the frequent references in Livy. Lease (52) has reviewed the subject and found that Julius Obsequens thought Livy's observations worthy of preservation in a book entitled *Liber Prodigiosum*. Livy apparently did not take very seriously the awful import of monstrous births, for he suggested that much of the popular talk on the subject was the product of an overwrought imagination. Indeed, the more enlightened of the ancients, as Hippocrates and Aristotle, attempted to explain monstrosities on natural grounds. Ballantyne (9) refers to Aristotle's ideas as representing the highest point of knowledge of monstrosities in 2000 years.

The period between Aristotle and the revival of learning is filled with crudity and cruelty in man's attitude towards monstrous births, which cannot be said to have disappeared altogether as yet. The various meanings attached to the word monster illustrate this state of mind. It has been derived from moneo, meaning "I warn," and monsters were regarded as a token of impending danger; to prevent this consequence they were killed and used as a sacrifice to propitiate the deities. Again, the word was related to monstro, meaning "I show," and monsters were considered to be forerunners of national disaster. This idea persisted into the seventeenth

century. A monstrous birth was also regarded as a punishment for sin. The mysterious influence of the moon is indicated in the most common interpretation of the word monster as meaning "moon-calf," "calf" being a lump or swelling, as in the expression "calf of the leg." Ballantyne (8) has discussed this term from the historical and etymological standpoints (1900). Another conception was that the gods were perpetrating a joke by making abnormal creatures, as suggested in the common expression "freak of nature" and the botanical term "sport." On the supposition that evil spirits inhabited monstrous forms, these were buried alive to get rid of the spirits. No definite chronologic order can be assigned to these theories, but in general the most crude were the most ancient.

The tendency to discover natural causes as opposed to supernatural is observed in such theories as that of abnormal content or quantity of semen and of menstrual blood, and the practice of coitus during menstruation (Kickham, 48) as the cause of monstrosities. Of more importance and longer duration was the theory of hybridity, according to which monsters were the offspring of a woman and a beast. This was easily imagined because of the superficial likeness of some monstrosities to the lower animals. The punishment inflicted for this fancied crime of the mother was death, often in a revolting form. In the sixteenth and seventeenth centuries women were burned to death in France and Denmark (Dareste, 20).

While not constituting so black a page in human history as the hybridity theory, the idea of "maternal impressions" deserves condemnation. This is not merely a notion of the ignorant but is a so-called scientific theory discussed with great seriousness in medical literature. Meadows (67) in 1865 described a fetus with its anterior belly wall open which was supposed to be the result of the mother's seeing one of Aristotle's plates illustrating a case of exomphalos. Hörrmann (43), in his thesis of 1903, treated the theory of maternal impressions at length, and apparently looked upon it with favor. Even a trained observer and student of teratology like Ballantyne (7), while admitting that there were weak links in the chain of evidence in the cases which he published in 1892, concluded that the question was still sub judice.

Kickham (48), in 1912, seemed to accept the theory. Beck (11), in 1916, was unwilling to dismiss maternal impressions as a scientific theory, though skeptical himself. It would seem a quixotic undertaking to combat this superstition were it not for its cruel aspect. It accentuates the grief of mothers and other innocent sharers in accidental occurrences which imagination, aided by friends and even by the family physician, conjures up to explain the consequences of an embryonic disaster occurring before the "impression" was received and often before the mother knew of her pregnancy. Even "paternal impressions" have been brought into the discussion. Mall (63) and Stockard (114) justly condemn the American profession for holding to these superstitions in the face of the overwhelming proof of their impossibility.

Serious attempts to explain monstrosities were made by scientific students in the middle ages. Ambrose Paré (88) published a book on the subject in 1573, and Licetus (60) in 1616. Morgagni (77,78) mentioned hydrocephalus as a cause of anencephaly in his *Adversaria Anatomica* in 1706 and again in his great work (*De Sedibus et Causis Morborum*) in 1761. Marcot discussed the same thing in 1716 (Ballantyne). Harvey (32) in 1651 suggested that cleft palate is a failure of union of the two sides of the upper lip, which originally stretches as a cleft from ear to ear, a condition which is normal in the hare and camel. Here is the principle of arrested development according to which certain abnormalities in man represent the persistence of an embryologic state which is normal in lower animals and through which the human embryo should pass as it recapitulates the phylogenetic history. This theory has been emphasized more recently by Meckel (68), Fleischmann (27), the two St. Hilaires, Darwin and others.

The chick embryo has long been a favorite subject of study because of its availability and its susceptibility to malformations. The artificial hatching of chickens was practiced in ancient Egypt, where the fact that many embryos were deformed was noted. Systematic attempts to alter the development of the chick date from the elder St. Hilaire (120) who published his history of anomalies in 1836. The younger St. Hilaire (121, 122) repeated his father's experiments and made others. He observed that changes in the egg before

the third day produced dwarfs or killed the embryo, while later changes produced monsters. Shaking the eggs, pricking them, keeping them vertical, partially covering them with wax and varnish, altering the temperature, and many other interferences resulted in monstrous growth. Dareste (20), following the St. Hilaires, contributed a wealth of knowledge to experimental teratology. It was not, however, until the last decade of the nineteenth century that experiment accomplished more than to establish the fact that changes in the environment of the growing embryo can lead to monstrosities. Undue importance was attached to faults in the amnion as the cause of constriction of the embryo; and the belief that most monstrosities are due to a defect in the germ cell and independent of influences operating after fecundation had the powerful influence of Meckel to sustain it. It is the recent experimental work, to be described later, which has placed cyclopia on a definite basis.

III. MODERN THEORIES OF TERATOGENESIS.

Piersol (91) has divided the modern history of teratology into three stages; the descriptive, during the last half of the eighteenth and the first half of the nineteenth century; the morphological, in which anatomico-embryologic details have been emphasized; and the experimental, including the last ten years, up to 1904 when his article was published. This third stage continued and reached its height, so far as cyclopia is concerned, in the years 1909 to 1913. It may be said that the description of the gross appearance of cyclopean monsters has been the principal contribution to the English literature, a fact which is due, in part at least, to the habit of preserving these specimens in the museums and refusing to allow their dissection. The German literature contains more of the morphologic details, with historic résumé, and theories borrowed from the French. The French philosophic tendency shows itself in classification and lucid discussion of experimental work. Much of this is outside the ophthalmic literature, and nearly all of it in England and America is to be found in the literature of embryology, anatomy, and pathology. To American science we owe the exceedingly important contributions

from the standpoints of investigations in the domain of pathologic embryology in which Mall's name is preëminent, and the experimental production of monstrosities of the cyclops type by which Stockard has clarified much of the confusion attending this subject.

Modern theories of teratology logically fall into two groups; the germinal, according to which the original germ cell of one or the other parent is abnormal and destined to produce a monster; and the non-germinal, according to which the germ cells, with no inherent vice, can produce a monster if their normal development is interfered with by detrimental influences acting after cell division has begun.

1. The Germinal Theory.

The tendency of certain abnormalities to occur in successive generations of a family has led to the belief that many, if not all, monsters are due to a germinal defect. Meckel (68) advanced this theory and stated that there is no possibility of alteration in the embryo after fecundation. That this explanation applies to some types of abnormalities is generally accepted. For example, Mall (63), who was a staunch defender of the doctrine that every ovum has in it the power to become a monster if subjected to an abnormal environment, accepted albinism, polydactyly, and certain legless conditions as germinal defects. The fact that a woman who aborts a pathologic ovum is likely to do so again has been taken to support the germinal theory, though the possibility of changes in the uterus persisting through the period of several pregnancies must be considered; thus, the same environment may be responsible for the successive abortions, and not a defect in the germ cells. His (41, 42) apparently considered cyclopia a germinal defect in 1882, but later (1899) inclined against this belief.

The most plausible exposition of this theory in regard to cyclopia was given by Wilder (131) in his "cosmobion" hypothesis. He would accept a germinal origin for all departures from the usual type except those which grow out of a defect in some system of functional importance or through a mechanical hindrance or direct injury. Cyclopia is thus of germinal origin representing one stage in a series of cosmobia, an orderly

sequence from an eyeless individual, through the cyclopean stage to two fused eyes in the middle line, two normal eyes in the usual positions, three eyes one of which is median and two lateral, to four eyes. These stages represent no monstrosity, but the various possibilities according to the tendency of the germ cells in obedience to certain laws. Wilder concluded that cyclopia is a cosmobion and cannot be produced experimentally. Within a year of his publication Stockard (115) announced the production of every stage in this series by modifying the chemical content of the sea water in which he grew fish embryos after cell division had begun. This was a most perfect example of a plausible theory overthrown by a stubborn fact.

2. *The Non-Germinal Theories.*

In spite of the impression made by Meckel's insistence upon the germinal origin of monsters, there have been many attempts to explain departure from the normal on the basis of factors acting upon the embryo after development has begun. These may be treated conveniently as the mechanical theory, the pathologic theory, and the embryologic theory.

a. The Mechanical Theory. This may be considered from two aspects, following Ballantyne's (9) description. Pressure may be produced from without, or may be the result of conditions within the maternal organism. External pressure may be general traumatism, as a fall or blow, or constriction of the mother's abdomen by corsets and tight clothing. Internal pressure may be divided into intra-abdominal and intra-pelvic on the one hand, and intra-uterine on the other hand. In the former, tumors, pelvic contraction and malformation of the uterus have been invoked as causes of monstrous development of the embryo. In the latter, uterine tumors, twin fetuses exerting pressure upon each other, the umbilical cord, and amniotic bands have been mentioned. The experiments of the St. Hilaires called attention to external influences acting upon the embryo. Guerin postulated muscular contractions of the uterus during convulsions, a theory which probably has no adherents now. Most of the causes assigned have been abandoned for lack of evidence of their validity; but the belief that

amniotic bands are responsible for malformation through pressure upon the embryo has been warmly advocated since the time of Dareste. He found such constrictions in chick embryos and laid great stress upon this factor which has been linked, by later writers, with his theory of a premature closure of the anterior end of the neural tube as the cause of cyclopia. Ballantyne discussed the various ways in which the amnion may act unfavorably upon the embryo, by disease, by pressure, and by arrested development. There can be no question that the amnion has received undue attention. Hydramnios is frequently found in monsters, and this is precisely the opposite condition to that of amniotic adhesions to the embryo; no amniotic bands are found in most human cyclopean monsters, both the full-term fetuses and the younger ones, as can be proven by Ahlfeld's (2) remarkable Atlas. Panum's (86, 87) two fetuses, one of six weeks and the other a little older, showed no amniotic adhesions. Mall has suggested that these are secondary and not causal factors when they occur. Ballantyne's observation is pertinent, that the uterus should not be thought of as a tight case, but that it is adaptable to its environment and that the liquor amnii is a protection to the fetus. Perhaps the most potent objection to the amniotic theory is the fact that cyclopia occurs in animals which have no amnion, and these are the very species in which it is possible to produce cyclopia with regularity by experimental methods, as will be shown later.

Dareste's Theory. Especial mention should be made of Dareste's (19) hypothesis of a premature closure of the cleft at the anterior extremity of the neural tube because of the large place it has occupied in subsequent literature; and it may logically be considered in this connection because of its association with the theory of mechanical pressure upon the embryo by amniotic bands. Dareste, in an elaborate discussion of the mechanism of cyclopia in the *Annales d'Oculistique* in 1891, referred to two hypotheses, that of the "union of similar parts" by which Meckel and St. Hilaire explained cyclopia as the result of the fusion of two eyes brought about by a more or less complete atrophy of the nasal apparatus, and that of arrested development, according to which the division of the originally single median eye (Huschke, 44) fails to take place.

Dareste would explain cyclopia as an arrest of development, most frequently due to amniotic adhesions. After reviewing the evolution of the neural tube and emphasizing the incomplete closure of the two ends, he discussed the formation of the anterior cerebral vesicle and the optic outpushings therefrom. The essence of his theory is that a premature closure of the anterior end of the neural tube would produce further extension of the tube forwards and prevent the normal elaboration of structures from its wall in a lateral direction. These structures develop from ectodermal cells which occupy successively the lips of the orifice of the first cerebral vesicle, and this "sliding" of ectoderm cannot take place after the cleft is closed. It is only after the optic vesicles are pushed lateralwards that the cerebral hemispheres can develop.

Although Dareste laid great stress upon amniotic bands, he stated, in his most important work upon experimental teratology (20), that he could not explain the premature closure of the anterior orifice of the neural tube by which the eyes would be arrested in the midline and the normal development of the brain hindered. Nevertheless his theory gained adherents and was quoted with approval by later writers. Unfortunately his practical agreement with Huschke in regard to the original median position of the optic anlage was apparently ignored. Neither Dareste nor Huschke was in a position to offer substantial proof of this theory, and it is only recently that experimental embryologists have demonstrated the original median position of the eye-forming material in the medullary plate. That Dareste's explanation of cyclopia is inadequate has been shown by the discovery of cyclopean fishes with the anterior end of the neural tube open, and by the absence of cyclopia in other species which habitually exhibit a solid tube.

b. The Pathologic Theory. The modern theory that pathologic conditions in the embryo are the causes of monstrosities is foreshadowed in the suggestions of Morgagni, Marcot, and Licetus which have been mentioned. Morgagni discussed hydrocephalus as a cause of anencephaly. Ahlfeld (2) mentions the early embryos (about six weeks) of Schlegel and Rudolphi which had a dropsical vesicle in place of a brain. Förster (28), in his important work on teratology, treats in detail

of fluid accumulations in the cerebrospinal canal. Beclard believed dropsy to be one of the most frequent diseases of the fetus. It is only in recent years that the pathologic theory has received much attention. The emphasis on amniotic adhesions appears in this as well as in the mechanical theory. Ballantyne (9) has classified numerous possible conditions in which various parts of the fetus may be adherent to the amnion; adhesions between different parts of the fetus, fusion of the fetus and umbilical cord, and displacement of the fetus outside of the amniotic cavity, all serve as deforming influences.

A different emphasis is found in the invaluable work of Mall (63) upon pathologic ova. From a study of 163 specimens he reached two conclusions which he considered as established beyond doubt; first, that pathologic embryos and small monsters are identical; second, that all of them developed from normal ova, due to external influences which he called "faulty implantation." His dictum, already quoted, is of great importance in the understanding of such a monstrosity as cyclopia, and is substantiated by the elaborate experimental proofs of Stockard: "every ovum possesses the power to become a monster." If the primary cause of the faulty implantation is slight the embryo may live to become a monster by being implanted correctly after the cause is removed, or poison eliminated. A more faulty environment leads to abortion. Mall considered at length various inflammatory conditions in the uterus acting upon the chorion. Endometritis causes abortions by producing inflammatory adhesions of the placenta and membranes. Hypertrophy of the decidua associated with abnormal forms of placenta is followed by arrest of development of the embryo. Atrophic endometritis means an atrophic decidua and retarded growth of the embryo. Hemorrhagic endometritis is due to a variety of infections. Hemorrhages in the chorion and placenta are often accompanied by bacteria or are due to nephritis. This may be followed by decidual infarcts and death of the embryo. While recognizing differences in opinion among the obstetricians, Mall accepted the views of Williams (134) and Ahlfeld as representative of the soundest judgment in obstetrical pathology.

Mall made use of statistics to show both the general importance of the subject of monsters and the bearing of his study of

pathologic ova upon this subject. He concluded that seven pregnancies out of every hundred result in pathologic ova. One third of these give well-formed embryo monsters, going to term in about 0.6%. Thus three well-formed monsters are aborted in the early months of pregnancy to every one which goes to term. Becker (12) stated that the proportion of monstrous births varies from 1–176 to 1–4000 according as only extreme cases or slight ones are included. Most monsters are females, as has been observed universally. Von Winckel (133) tabulated 87 monsters in 12,378 births in Dresden, one to every 142 children born. There were 105 monsters in 20,000 births in Munich. Of eighty-seven monsters, twenty-three had the head involved and twelve the face. The exposed position of the head end of the embryo is given as the explanation of the preponderance of malformation in this region. Thus anencephaly occurred in 20% while spina bifida was found in 7% of a series. Panum's (86, 87) tabulation shows 16 cases of cyclopia in 618 monsters. Von Winckel (132) found 96% of pathologic ova in extra-uterine pregnancies. This goes far to substantiate Mall's idea of faulty implantation, since no germinal defect can be supposed in so large a percentage of those ova which remain in the tubes when only 7% of intra-uterine pregnancies show pathologic ova.

c. The Embryologic Theory. Harvey's idea that cleft palate is an arrested development, by which the human embyro ceases its evolution at a stage which is normal for the hare and camel, has been mentioned. Meckel emphasized this conception which accords with the well-known embryologic "law of recapitulation." Attempts have been made to explain arrested development by a failure in some tissue which is thought to dominate development. Thus, supposing that the nervous system is dominant, cyclopia would be due to an absence of the olfactory nerves. The ethmoid would not develop without the influence of the olfactory nerves, and the eyes would come together. If the medulla were absent, the face could not develop. On the supposition that the heart and blood vessels are dominant, cyclopia would result from a failure of blood supply; even anencephaly might result. Ballantyne (9) raises the question whether the small size of the internal carotids is the cause or effect of anencephaly. The possibility

that some untoward influence may lessen developmental energy in the embryo is strongly suggested by recent experimental work, but there is no very great stress laid upon the theory of arrested development, in the Darwinian sense, in recent years.

IV. THE EYE IN CYCLOPIA.

Cyclopia, in the narrow sense of the word, means a single eye in the lower middle portion of the forehead. Anophthalmos and monophthalmos are not included in this definition. Cyclopia has been used in a broader sense, to include a variety of conditions in which there is more or less fusion of the eyes in a median position with incomplete separation of the orbits. A single orbit in the midline with no eye is called anophthalmia cyclopia, or cyclopia reduced to its lowest terms. The variability of the deformity is so great that, for practical purposes, it is advantageous to use the word cyclopia in its broader sense. Numerous classifications have been attempted and grades of cyclopia are mentioned accordingly. Bock's classification, quoted in the Graefe-Saemisch *Handbuch* (40), is as follows:

1. Eyes close together, each in a separate orbit; nose narrow, with a single cavity.

2. Eyes close together; two orbits; nose with a single cavity pushed out like a beak sitting on the curtailed nasal bone in the forehead.

3. One orbit; two eyes close together; scleræ joined, two optic nerves.

4. Optic nerves close together; common scleræ thinned; cornea, iris, lens, and vitreous doubled.

5. Cornea single; iris, chorioid, vitreous, and retina doubled; nerves separated by a thin layer of connective tissue.

6. One cornea; two lenses fused in the center; chorioid, sclera, retina, and optic nerve single.

Practically every conceivable degree of fusion of the various structures composing the eye has been described, and there is no great value in arbitrary classifications. The lids share but little in the deformity because of their later development and independence of that portion of the ectoderm which is very early differentiated into nervous tissue. For the same reason the bony structures of the head and face are affected secondar-

ily. Those structures which normally develop between the eyes naturally suffer most. In the case of the lids they suffer only in so far as their median halves are fused and they are separated and retracted by an eye which is abnormally large as a general thing. There are four lids or three lids (one above and two below), bounding a lozenge-shaped space through which the eye protrudes with the cornea exposed. The horizontal diameter of this space is broader than the vertical. The lid tissues are frequently normal. The external angles are less acute than normal. The junction of the two upper lids in the midline may be inconspicuous; the junction of the lower lids is more evident and may show a caruncle. Variation in fusion of the lids has given the appearance of five lids or of one circular lid. The puncta may or may not be present. The canaliculus and tear sac usually share the fate of the nasal apparatus; the canaliculus may end in a blind sac.

The exposed surface of the eye presents a somewhat dumb-bell-shaped cornea with its long axis horizontal; one or two pupils may show through the cornea. The globe is generally shallow, because of the shallow orbit, and the posterior segment is diminished in size so that it appears as a pedicle to which is attached a broad, flattened anterior segment, the whole having the appearance of a mushroom. There is a more or less conglomerate mass of muscle tissue in which the individual muscles are made out with difficulty. The internal recti naturally do not exist. The eye is generally larger than a single normal eye, but less than twice this size; it may be smaller, and anophthalmos is a possibility. Of course, no credence can be given to reports of anophthalmos without microscopic examination of the contents of the orbit, and most of the cases reported unfortunately describe only gross appearances. Huschke (44) quoted several reports in the literature, but they were not confirmed by microscopic study. Nieden's (84) case is not convincing for the same reason. Owing to union of the eyes in the region of the fetal cleft, colobomas and colobomatous cysts are frequent. Van Duyse (24, 25) has written at length on this subject.

The various tissues composing the eye present all degrees of mal-development. They may approximate the normal, but usually they exhibit the imperfect differentiation characteristic

of fetal eyes. Few cyclopean monsters come to full term and the specimens studied in man and other vertebrates are generally premature. The cornea is less sharply distinguished from the sclera than normally, having the fetal mesodermal characteristics, with poor development of Bowman's and Descemet's membranes and imperfect laying down of the lamellæ of the substantia propria. The sclera is thinner than normal. The iris may be poorly developed, the pupillary membrane retained and the anterior chamber shallow. The rest of the uveal tract may be normal; but in one eye it will usually suffer at the expense of the other, as both eyes are seldom equally developed. The retina presents rosette-like folds as in the fetal state, and generally shows greater or less imperfection in the nerve fibre and ganglion cell layers. This is especially true of the cases in which the central nervous system is greatly altered. Normal retinæ have been described in a few instances. The vitreous is usually very small, owing to the orbital deformity which causes a very shallow globe. The optic nerve exhibits all variations from a normal condition to absence of the nerve. No characteristic or habitual type can be described for any of the ocular tissues, since they vary so widely in different eyes. The more carefully studied specimens, as those of Hayashi (33), Van Duyse (24), Gabrielides (29), and Oakden (85), reveal such departures from the normal as one would expect to find in the crowded confines of the cyclopean orbit. All of the tissues tend to be more abnormal in the lower segment of the globe.

The deformity of the orbit is essentially an absence of the ethmoid bone. The orbital processes of the superior maxilla and the lacrimal bone make the floor of the orbit, and processes of the frontal, or a cartilaginous structure, make the roof. The greater part of the orbital rim is made by the zygoma, or the orbital processes of the malars and the greater wings of the sphenoid. Obviously these relationships vary according to the very variable degree of the cyclopean deformity.

V. OTHER DEFORMITIES ASSOCIATED WITH CYCLOPIA.

In order for the eyes to occupy a median position, considerable disturbance in the relations of other tissues of the head

and face must take place. The most conspicuous of these is the failure of the olfactory apparatus. The nose is usually represented by a proboscis above the cyclopean eye, which the ancients regarded as a penis. This protuberance hangs from the forehead over the eye, presenting a dimple at its extremity which marks the entrance to a lumen which usually admits a probe for several millimeters. There may be cartilaginous tissue and glands in the proboscis and occasionally relics of nervous tissue, though the olfactory nerves are generally absent. The ethmoid fails, and the sphenoid is more or less in abeyance. The horizontal process of the frontal is unable to descend and remains rudimentary or absent. Dareste (19) has explained the bony abnormalities as follows: the buccal orifice is limited below by the inferior maxillary branches of the first branchial arch which arrive in contact in the median line, laterally by the superior maxillary branches which are buds from the inferior maxillary. The superior maxillary branches mount almost vertically to just below the eye, turning slightly around the anterior part of this organ to become applied and fused against the lateral parts of the fronto-nasal process. The fronto-nasal bud limits the buccal orifice above. This opening is quadrilateral. The eyes occupy the two superior angles and are separated by the whole diameter of the fronto-nasal bud. In case of cyclopia, the eye having become situated in the midline, the fronto-nasal bud cannot descend and occupy its place between the two superior maxillary branches. It remains above the eye where it is more or less modified. The superior maxillary branches cannot continue to develop. Not encountering the fronto-nasal bud, they remain below the eye and unite with each other. The buccal orifice which normally has a quadrilateral form, presents in cyclopia a triangle with the base below and the apex remains under the eye. This form of mouth is characteristic of cyclopia. The nasal fossæ are not separate but become one cavity above the eye and never come into contact with the mouth.

The anomalies of the brain in cyclopia vary greatly; they do not correspond precisely with the degree of cyclopia, since the original disturbance may affect little or much of the neural tube. The most typical changes are the absence of the olfactory system and chiasm, and the unpaired hemispheres and

optic centers. The optic nerves may be absent, with a corresponding failure of the nerve fibre and ganglion cell layers of the retina. That the causative factor may operate upon the optic anlage alone is evident in lower forms where cyclopia may exist with a normal brain. Lewis (59) and Stockard (109, 115) have found this condition in the fish, fundulus. In man there is always a defective brain. Mall (64) says that the anatomical changes in cyclopia can be produced by removing the structures represented along the raphe of the medullary plate reaching from the mammillary bodies to the neuropore. The forebrain and midbrain are narrow in proportion to the union of the eyes and orbits, so that a cyclopean monster at term may have the brain of a twelve-weeks embryo. The hemispheres are single; the ventricles are fused into one cavity. Hydrocephalus is frequently present, and the skull may develop to full size as a result of the large amount of fluid even if the brain is rudimentary. Extensive failure of the neural tube to develop may result in anencephaly and absence of the spinal cord, as in the case described in this paper. Black (14), in an exceedingly valuable study of the central nervous system in cyclopia, calls attention to the varying conditions in the forebrain due to mechanical reasons not at all in accord with the degree of cyclopia. The midbrain will vary accordingly to the growth inhibition at so early a stage that it practically amounts to absence of certain tissue anlagen. Black (14) illustrated the defect in his case by the use of one of His's models of a brain at the end of the fourth week. The telencephalon is at that time a thin-walled unpaired vesicle. Marking out the areas on the ventral surface which will later develop into the corpus striatum, rhinencephalon, pars optica, and pars mamillaris hypothalamica, and cutting out the anlagen of those tissues which have not yet developed, he had left what was preserved in the brain of his specimen. Usually the brain defect is so great that human cyclopean monsters cannot live. Ahlfeld (2) says that they are not viable, though Von Hippel (40) refers to cases which lived 6 weeks, 18 months, and 10 years. Valenti (124) stated that one case lived 73 hours. The case living 10 years can scarcely be credited, unless a fairly normal individual with eyes very close together was classed as cyclopean.

Hydramnios is frequent in cyclopean as in other monsters. This is also true of heart anomalies, as shown by the edematous tissues and fluid in the serous cavities. Mall (63) would explain the marked abnormalities as evidence of not only an arrested development but an extensive histolysis and necrosis of tissues taking place in the embryo as a result of impaired nutrition.

Abnormality of the suprarenal bodies has been found in cyclopia together with absence of the superior cervical ganglia. Biessing (13) found aplasia of the suprarenals in each of 19 cyclopean fetuses, but did not find the sympathetic ganglia altered. He cautions against assuming the absence of the suprarenals which may be very small and embedded in fat.

VI. THE MECHANISM OF CYCLOPIA.

The marked bony defect in cyclopia suggested to early observers a primary fault in the osseous system with a secondary fusion of the eyes. Meckel (68), the St. Hilaires (120, 122) and Manz (65) postulated an atrophy of the nasal apparatus. Panum (86, 87) considered the failure of the ethmoid bone the essential cause of cyclopia. Dursy thought that the middle process of the frontal bone did not develop and so the superior maxillaries joined. Bock (15) suggested inflammation affecting bone and periosteum with fusion as the cause of deficient growth of the anterior part of the skull; this affected chiefly the ethmoid and sphenoid in his case.

Ahlfeld (2) called attention to the essential error of all of these hypotheses when he announced that the embryologic seat of cyclopia is the brain and not the skeleton. According to this conception, Hayashi (33) would explain cyclopia as the result of a failure of that part of the brain which bears the olfactory system. Dareste's (19) theory of the premature closure of the cleft at the anterior end of the neural tube has the virtue of calling attention to the brain rather than the skull as the primary seat of the disturbance. Becker (12), Gravelotte (31) and Ballantyne (9) accepted this explanation. Aschoff (3) questioned the narrowing of the headpiece of the amnion as a factor in the deformity of Dareste's chicks and suggested that they probably had a very early median brain

defect. Hadlich expressed the same idea in regard to cyclopia. Richter stated that the originally single brain anlage does not divide in cyclopia. Taranetzky thought that the entire front part of the embryo's head is abnormal as a result of outside pressure which may be the result of a narrow amnion or of inflammatory changes. Individual cases of cyclopia furnish examples of these causative factors and one readily sees how each of the various associated deformities has impressed some observer with its importance. The secondary place of all bony abnormalities in cyclopia has gradually been established. It is desirable to go a step further and concentrate attention upon the eyes rather than non-ocular tissue. That cyclopia is not a passive apposition of the eyes because nothing comes to separate them but is a fault in the original eye-forming material is proven by the experimental work of Stockard to be described later. This work is part of the large contribution of experimental embryologists to the problem of the mechanism of such monstrosities as cyclopia, and will be discussed under the separate heading of modern experimental teratogenesis.

VII. DESCRIPTION OF THE AUTHOR'S SPECIMEN, A CYCLOPEAN MONSTER WITH ABSENCE OF THE BRAIN AND SPINAL CORD.

I am indebted to Dr. S. W. Budd, of the department of Embryology in the Medical College of Virginia for the privilege of studying a cyclopean monster which was sent to him by a practictioner. Dr. Budd generously allowed me to dissect this specimen instead of keeping it for museum purposes, and aided in interpreting the embryologic peculiarities which it presented. The histologic study was made in the laboratories of embryology and pathology in the Medical College of Virginia.

The specimen was a white, female, human fetus of 7 or 8 months with a well developed body excepting the marked anomalies of the head and back. No history accompanied the specimen and we know nothing of the parents or their other offspring. The fetus measured only 28*cm*, because of the absence of the cranium; the legs and arms were folded and the attitude of the body with a flattened head was very much like

Text-Plate XXI.

Arch. of Ophth., Vol. XLIX., No. 6.

ILLUSTRATING DR. HILL'S ARTICLE ON "CYCLOPIA, ITS BEARING UPON CERTAIN PROBLEMS OF TERATOGENESIS AND OF NORMAL EMBRYOLOGY; WITH A DESCRIPTION OF A CYCLOCEPHALIC MONSTER."

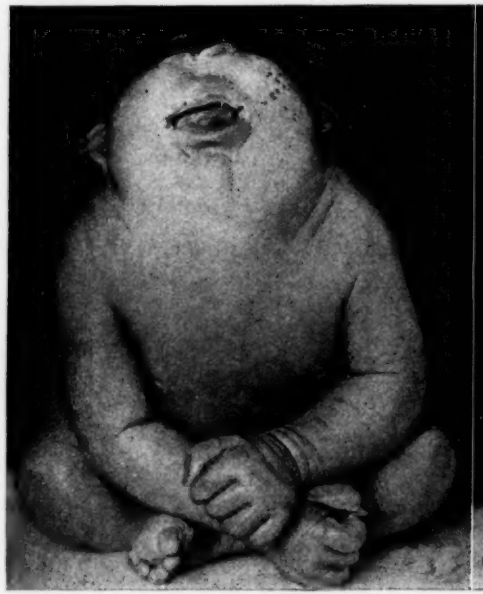


FIG. 1.

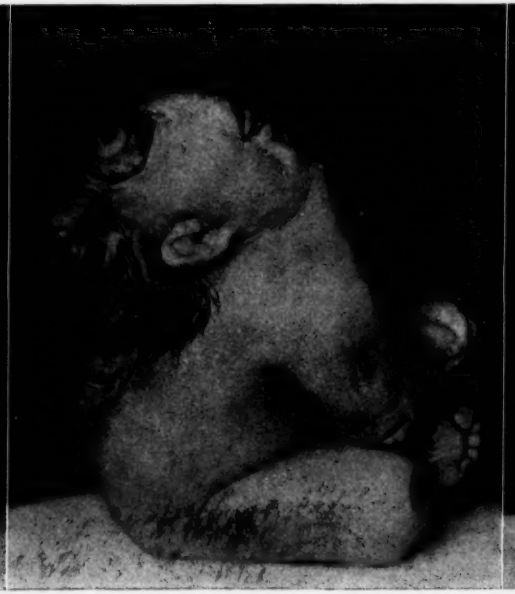


FIG. 2.

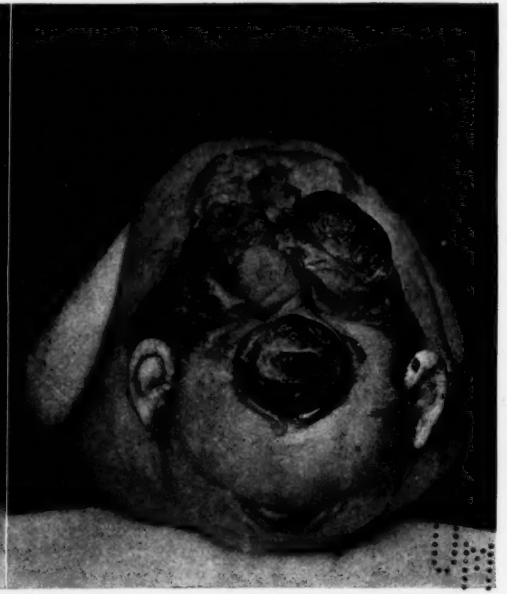


FIG. 3.

that of a frog. The head was bent backwards allowing the chin and chest to form a straight line. The mouth was open, and a large, thick tongue protruded. A large eye occupied a median position low down in the forehead, looking upward; and a proboscis lay just above and behind the eye. A fungus-like mass of dark gray substance occupied the position of the head, extending down the back to the level of the iliac crests. Between this mass and the ear on each side was a growth of brown hair. The left ear showed several dark pigmented spots; otherwise the skin was normal.

The palpebral opening was lozenge-shaped, the fissure being 12*mm* antero-posteriorly (corresponding to the vertical width in the normal position of the eye). The two upper lids were fused into one, their edges making one curved line with its convexity backward; the lower lids (anterior in this specimen) united at a rather sharp angle in the midline, making a narrow cleft. No caruncles were seen. The lids bore delicate cilia, but no trace of puncta could be discovered. The eye protruded, the lids being retracted behind the rounded border of the anterior segment of the eye which sat like the top of a mushroom upon a short thick pedicle which constituted the posterior segment of the eye. This posterior segment, 5*mm* in depth, together with the muscle cone, filled the shallow orbit, the flatter anterior segment being outside the orbit. The anterior flattened segment was practically circular, with a diameter of 28*mm* and varied in color from a deep brown to gray, to flesh color. Two corneas were made out in this exposed surface. The combined corneas measured 15*mm* by 7*mm*, the longer diameter being transverse; the right cornea was of a milky color, the left fairly transparent. A dark gray-brown, vertical band 4*mm* wide separated the two corneas. This appearance suggested two pupils and irides.

The proboscis measured 18*mm* in length, 13*mm* in width, with a constricted base 8*mm* wide attached firmly to the deep tissues just behind (above in the normal position) the orbit. Its lumen admitted a fine probe for a distance of 8*mm*.

The mass occupying the head region extended 3.5*cm* down from the base of the proboscis, had a width of 5*cm*, and protruded backwards 3*cm* from the neck. It was roughly divided into two masses, the left being the larger, which appeared to

bulge from a sort of capsule. Below these masses was a grayish tissue, 4.5 x 4.5*cm* in extent, having a parchment-like feel, flattened against the spinal column, gradually fading into normal skin below and at the sides. One gets the impression that the dura was preserved in part and covered a mass of undifferentiated brain tissue. A small amount of fluid was pressed from the depths of this mass, probably formalin in which the specimen had been preserved for a long time. This entire mass was easily peeled away and revealed the practically entire absence of a skull cavity, and no spinal cord or canal, the vertebræ being represented by their bodies alone without processes or laminæ. There was a marked kyphosis in the lumbar region.

In order to obtain the contents of the orbit uninjured, the upper lids were removed with the roof of the orbit. This was very thin and small, since the orbit was extremely shallow. The posterior segment of the eye was surrounded by a mass of muscle and fat through which two superior recti, two inferior recti, and two external recti appeared to force their way. The identity of these muscles was suggested by their location; it was impossible to find any nerves supplying them, by the tracing of which to the brain one might identify the nerves and consequently the muscles. No obliques were found. The muscle tissue formed a short cone with its apex where the orbital foramen should be, and its base just behind the flattened and wide anterior segment of the eye. The orbital contents were removed together with the root of the proboscis which was firmly attached to the skin and deeper tissues immediately behind the orbit. The lacrimal glands were not found. An optic nerve-like tissue extended 5*mm* back of the eye where it was lost in the apex of the muscle cone. No optic foramen was found.

Dissection of the face and head region revealed a profound alteration in the bony framework. The mouth was well formed, the maxillæ forming upper and lower jaws with well developed gums. The tongue was large and thick, filling the mouth and protruding. The superior maxillæ were fused in the midline, not only by means of their alveolar processes to form the upper jaw, but the facial surfaces and nasal processes likewise met in the midline, so that a solid bony wall extended

from the mouth to the lower orbital rim which was formed by the two maxillæ. The infra-orbital foramina were distinctly made out, each carrying what appeared to be a nerve. The floor of the orbit was made by the orbital surfaces of the two superior maxillæ. The nasal cavities were absent and there was no trace of the ethmoid, nasal, lacrimal, palate, and turbinate bones, or the vomer. The distorted shape of the orbit made it impossible to distinguish a definite roof and outer walls. The rim extended two-thirds of the way around, being deficient above; the two superior maxillæ, the orbital processes of the malars and the greater wings of the sphenoid made up the rim. The malars and greater wings of the splenoid constituted what were regarded as the outer walls. A thin bony structure, which was the only suggestion of a frontal bone, covered the back part of the orbit above the apex of the muscle cone and apparently represented a roof.

The zygoma was well developed, and the malar bones and squamous portion of the temporals were practically normal. The petrous portion of the temporals was small and the mastoid portions normal. The body of the sphenoid was distorted so that no definite sella turcica and clinoid processes could be distinguished; the lesser wings were absent. The bony development was greater on the right than on the left side. The posterior boundary of the shallow skull cavity was made by a fused mass of bone presenting a median body and two lateral processes. This could not be identified certainly as a rudimentary occipital bone or atlas, or both. Each lateral process bore an articular surface, convex below, but there was no definite articulation with the solid bony spinal column. The parietals were absent.

The thymus gland measured 28 x 18*mm* with the long axis transverse. Its anterior surface was furrowed horizontally by a large venous trunk representing the common cardinal vein and two vertical branches of this vein. The lungs were flat and contained no air. The heart was very anomalous in shape, being 39*mm* transversely and 27*mm* vertically, instead of the usual vertical, cone-shaped fetal heart. The blood vessels were normal with the exception of the greatly enlarged common cardinal vein and the disproportion in size of the two common carotid arteries, the left being much larger than the

right. This fact is interesting in view of the better development of the right segment of the eye and the right half of the bones of the skull. The attempt has been made to correlate these differences in development with differences in blood supply, as has been mentioned in discussing the embryologic theory of teratogenesis.

The abdominal cavity showed the usual large fetal liver, measuring 6 x 6*cm*, normal kidneys, but no visible suprarenal bodies. Biessing (13) has warned against the assumption of absence of these bodies which may be concealed in the perirenal fat. There was evidently a great aplasia, if not absence, of the suprarenals in this specimen. No spleen or stomach was found in the abdominal cavity. A very striking anomaly above the diaphragm explained this circumstance. In a separate compartment bounded by the diaphragm below and a smaller structure similar to the diaphragm above, separating this intermediate cavity from the thorax, were found the stomach and spleen, as proven by histological examination. The spleen measured 18 x 18*mm*, being roughly divided into three lobes, the larger being twice the size of each of the others. Apparently this anomaly represents a failure of descent of the pleuro-peritoneal membrane which is one of the structures destined to enter into the formation of the diaphragm, so that the stomach and spleen lay between two leafs of the diaphragm.

The Levaditi stain of liver tissue showed no spirocheta pallida, nor was there other evidence of congenital syphilis. The peripheral nervous system was normal except for the head region.

(*To be concluded.*)

NEUROPATHIC KERATITIS SETTING IN LONG AFTER ALCOHOLIC INJECTIONS INTO GASSERIAN GANGLION FOR RELIEF OF TRIGEMINAL NEURALGIA.[1]

By Dr. BURTON CHANCE, Philadelphia, Pa.

IN recent years surgeons have boldly attempted to relieve neuralgia of the trigeminus by the resection of the nerve branches; by the extirpation of the Gasserian ganglion; and by the direct destruction of the ganglion through the injection of coagulating fluids, notably alcohol, into the ganglion. Such procedures sometimes have led to serious complications through interference with the nutrition of parts supplied by these nervous structures. The following communication in which are the outlines of a case which presented to me unusual clinical features, I trust may not be found uninteresting to those whose day's work is more varied than my own.

On December 24, last, I was consulted by a man of 45, who stated that on arriving at the railway station in Cleveland, Ohio, on the night of December 1, he found the sight of his left eye to be greatly blurred and the lids and the globe most uncomfortable. He believed that a cinder had lodged on the eye, yet, he was not capable of judging accurately because in the past two years the eyeball had been markedly anæsthetic consequent to a series of operations on the trigeminal nerve, on the left side, as well as upon the Gasserian ganglion. In the succeeding days the symptoms continued without abatement, and he returned to Philadelphia.

The patient declared that he had never had an injury nor disease of either eye, but in recent months he had had in mind the need for presbyopic correction glasses. He gave

[1] Read at meeting of American Ophthalmological Society, 1920.

an interesting history of the surgical treatment of trigeminal neuralgia, confined to the left side, from which he had suffered persistently for many years. He had had several teeth extracted; repeated operations upon his nasal structures; the resection of the supraorbital and of the infraorbital nerves; all ineffectually, but he was finally relieved by alcoholic injections into the Gasserian ganglion, for, in February, 1917, alcohol was injected into the ganglion at the hands of Dr. Charles H. Frazier. From that time he had been entirely free from pain, although singularly uncomfortable, because of the anesthesia of the regions supplied by the trigeminus.

I found on examination slight conjunctival, but quite distinct pericorneal injection of the globe, with only scanty lacrimation. The corneal surface was œdematous and without sparkle. There was no apparent loss of substance, and on a closer inspection, it seemed to be pervaded by fibrillar scars. The membrane was totally anæsthetic to the touch of a wisp of cotton. There were no evidences of herpetic formation. A tiny mass, presumed to be a foreign substance, proved to be only a collection of mucus.

The iris was not inflamed although it reacted to light sluggishly. The fundus was visible in spite of the obscuration of the cornea; there was nothing worthy of note therein, the nerve head being healthy. The visual acuteness of the right eye equalled $\frac{6}{7.5}$ and of the left $\frac{6}{6}$.

I instilled solutions of atropine and holocaine and prescribed a preparation for frequent use in the ensuing 48 hours, and then applied a light patch-bandage.

On December 26th, the eye was quite free from injection, both superficial and deep, yet the corneal œdema had increased, and quite obscured the deeper structures. On the next day the œdema was less, but there were diffused throughout the cornea illy defined hazy spots. It was possible to see the fundus faintly and $V = \frac{6}{18}$. Two days later the epithelium for nearly the whole extent was found to have been exfoliated and the entire membrane was intensely edematous. Dionin was instilled and the lids were sealed with strips of plaster. Two days later the œdema had subsided, and, $V = \frac{6}{12}$. Two days later there was no œdema, and the exfoliated area had become filled in at the nasal half, but there was a strange horizontal streak, like an old cicatrix, in the anterior layer of the substance. At no time was there infection of the denuded area.

At the end of the 10th day after consulting me he was so comfortable that I consented to his going back to Cleveland to attend certain important business engagements. On January 8th, he reported that he had had no discomfort

except when he read for a length of time; but on January 11th, he wrote that the eye had become inflamed and was uncomfortable and that the lids were puffed, in spite of his having worn the light bandage constantly. I wired that he should consult Dr. William Bruner; who informed me that he had found on the 15th a greatly congested eye; the cornea of which appeared to have been denuded entirely of its epithelium. Yet, by the 19th, the epithelium became restored and only a central cloudiness was present. He prescribed a mild antiseptic ointment and had applied a light compressive bandage. Because of the general history, the signs were at first sight most alarming, and he was for a time considerably worried as to the possible outcome of the case.

In the meantime I learned from Dr. Frazier that "at the University Hospital in April; again in May, and again in June, 1916, he had injected alcohol into the ganglion without relief in the first and second instances, but following the third there was relief for two days. On January 29, 1917, he attempted to inject the third division of the nerve and through it the ganglion, which maneuvers were without success as he failed to reach the division. On February 5, 1917, he resected the supraorbital branch, and on February 19, 1917, he resected the infraorbital branch of the trigeminus, and on February 28, 1917, 1.5*cc* of alcohol was successfully injected into the ganglion by the Härtel technic." The man declared to me, at his first visit, that from the last date, he had been entirely free from neuralgia, although the sight of his left eye had lost its acuteness after this last injection. It was not possible for me at my first examination to obtain satisfactory visual tests because the cornea was so clouded.

He is a tall man with a hollowness of his left cheek, the skin of which is "moth eaten" and the tissues scarred, which scarring followed the healing of the resection of the infraorbital nerve; and, there is a quite broad linear cicatrix in the superciliary line, from the removal of the supraorbital. In the tracts embraced by the nerve there is complete anæsthesia to the points of the esthesiometer. The anaesthesia is limited to the left side without crossing the median line; the limitation being marked in the manner one observes in zona ophthalmicus, and extends to the ala and tip of the nose. The skin of the scalp, forehead, and face is scaly and exfoliates persistently. There are no pareses of the ocular muscles, but there is a lack of tone in the external angle of the mouth so that sometimes there is dribbling.

On January 23, 1920, the patient returned wearing the bandage which had been applied by Dr. Bruner. I found

that the epithelium had become restored although there was edema of the cornea and a central cloud which on magnification consisted of a curious latticing beneath Bowman's membrane. The separate strips were of approximately equal breadth, but each end was slightly tapering. These lines were made up of fine grayish white dots, and all were surrounded or bathed, as it were, in a bath of tiny granules.

On this date I prescribed tablets of chromium sulphate, gr. iv, to be taken four times a day. I bathed the eye in warm sterile water, and instilled atropine and holocaine. The lids were then sealed and a light compress was applied. This treatment was cautiously repeated daily. By January 30th although the membrane had cleared greatly, there was still a central denudation, but the latticing was not so pronounced as it had been. The clearing continued; but when examined four days later, the epithelium was again seen to be cast off. For the next ten days the lids were kept sealed after a daily morning dressing, so that by February 13th the epithelium was again restored, although there was a "guttate edema" with faint lines as described above. Dionin powder was dusted on and by February 17th the eye became white again, the corneal surface restored, and the edema completely subsided. Because of a slight discomfort, on awaking, which I adduced to an irritation of the cornea caused by the first opening of the lids, the patient was advised to wear a patch-bandage at night. On February 28th the eye was quiet, and except for a small central haze it was so healthy that V = $\frac{6}{15}$. At the end of March, V = $\frac{6}{7.5}$ despite an amorphous, yet translucent haze. The fundus was found to be entirely healthy. The chronium tablets which had not been taken for three weeks, were again prescribed. On May 11th, after an interval of twenty-one days, the eye was found to be entirely well and was seen to be free from all symptoms except a faint superficial haze; V = $\frac{6}{7.5}$; that of the right $\frac{6}{6}$.

The history here cited is based upon frequent examinations in which were used such magnifying instruments as were available. The corneal manifestations were such as I had not seen before, by this I mean, any case exhibiting such extensive denudation followed by restoration after so short an interval. There was nothing suggestive of herpetic formation, yet I regarded the process to be analogous to herpes. The repetitions of the intense edema were as alarming as the subsidence of it was astonishing. The picture of the deeper manifestations I had no recollection of having ever seen. The fine grayish dots which seemed to pervade the stroma, superficially, and the formation of the lattice were of absorbing interest. The latticing I considered to be

the lymph spaces of the cornea, and the grayish dots to be colloid material circulating through the stroma. The latticing was not at all comparable to the fine twigs one sees in dendriform keratitis. There were no localized necrotic areas to hold the fluorescin, indeed the stain was easily washed away. Giri, in his report of a case of indolent ulcer, before the Ophthalmological Society of the United Kingdom, last year, described a quite similar formation. At my examination a day or two ago there was present only a faint superficially interstitial haze. It is remarkable that the iris continued so little affected.

The length of time intervening before the onset of the keratitis in my case is remarkable; from February, 1917, to December 1, 1919, is indeed a long delay for trophic changes to set in after such treatment as this man was given. The injection was without doubt so sufficiently effective as not only to relieve the distressing tic but also to have rendered the cornea anesthetic. Of course, it is not known for how long in a given case the influence of the alcohol can last, nor has it been settled by post-mortem studies, I believe, just how great is the destruction of the ganglia. Little or much as an injection might destroy, the alcohol certainly renders the nervous tissues susceptible to any disturbing factors during the period of influence of the toxic element. In my case in the period succeeding the last injection the man was in what he believed to be perfect health. His teeth were not diseased, nor were his tonsils; his nasal cavities had been subjected to thorough examinations and were considered to be not diseased. It might be that a cinder or other foreign particle lodged on the cornea which by irritation had excited the reaction. But I am not inclined to view the reaction as external in origin; on the contrary, I believe it to have been caused by tropic changes arising in the nervous supply to the cornea.

I admit that it might be disputed that the keratitis was directly dependent upon the injection of alcohol into the ganglion. It is true that branches of the trigeminus had been resected and that more than one injection had been given, but all unavailing and after none of these had there been untoward symptoms. It remained for the final injection to affect cutaneous sensibility, reduction of lacrimation, and corneal anesthesia. I am, therefore, led to ascribe the symptoms to destructive processes in the ganglion itself produced by the alcohol.

Not until this case came before me had I had any personal contact with one who had had an injection of alcohol into the nervous ganglia. As it is not unlikely that there are others of

this Society who have not had such cases, it might be worth while to state that probably Härtel's report of twenty-seven cases treated, in Bier's clinic, by injection of alcohol into the Gasserian ganglion, has stimulated surgeons in America to the performance of this delicate yet comparatively simple operation. The procedure has been so recently introduced into surgery that but little data has accumulated. In personal communications from Drs. Cushing, Frazier, Sharpe, and Adson, of the Mayo Clinic, the procedure is regarded as dangerous and certainly likely to lead to such serious complications as ulceration of the cornea. The advocates of the direct alcoholization of the ganglion, on the contrary, consider it to be equivalent, as far as the immediate physiological effects are concerned, to the extirpation of the ganglion, yet without the dangerous sequels of a ganglionectomy because the effects are gradual in their development. New Orleans surgeons, including Matas, Maes, Allen, Nix, and others who practice the method freely, offer it as a means of curing tic douloureux. They declare it to be devoid of the usual dangers accompanying intracranial operations on the ganglion. In twelve cases Allen found no evidences of inflammation of the eyes. The trophic lesions have been found to be not so pronounced as those which follow removal of the ganglion. Because the cornea becomes anesthetic after a successful injection, ulcerations are not unlikely to occur. Härtel, after his first ten injections saw two develop keratitis, and Maes had one in whom a leukoma developed, which cleared up later. Allen mentions cases as having occurred in his experience. So far as it has been possible for me to search the literature I have not found any description comparable to the case here detailed.

Härtel's results show that destruction of the ganglion must have been fairly complete, not even considering the cases of neuroparalytic keratitis. In his 27 cases reinjections were rarely necessary. The period of relief averaged 8 months. Bruner has had a case which was relieved for a few years; on the recurrence of the pain the ganglion was removed, but the eye continued sensitive and irritable. Allen is convinced that when the value of injections for the relief of neuralgia is recognized they will be used extensively. In my own case although two unsuccessful attempts were made, the relief the

patient has had for three years since the third was given has been so great that he regards his recent affection as merely a discomfort and the result as justifying the procedure.

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TRANSIENT HERPETIC RASH OVER THE AREA OF DISTRIBUTION OF THE OPHTHALMIC BRANCH OF THE FIFTH NERVE FOLLOWING APPLICATION OF BLUESTONE IN A CASE OF PARINAUD'S CONJUNCTIVITIS.

By Dr. MATTHIAS LANCKTON FOSTER, New Rochelle, N. Y.

A BOY, 14 years old, presented a typical picture of Parinaud's conjunctivitis of his left eye. The upper fornix was distended by a turgid mass of acuminate growths, the apices of several of which were yellow. The conjunctiva passed smoothly over all of these, with the exception of one, the yellow apex of which was ruptured. Nothing resembling pus could be obtained either from this, or from other yellow apices. The left preauricular gland was swollen and firm, the left parotid and submaxillary glands swollen to a less degree. The left tonsil and the cervical glands on both sides were swollen and remained unchanged throughout the attack. Microscopic examination of a portion of the mass of acuminate growths showed a loose fibrous connective tissue matrix very densely infiltrated with small round cells and polymorphonuclear leucocytes.

A few days later bluestone was applied in the hope of reducing the turgescence of the conjunctiva. This application was immediately followed by a rash resembling a fresh attack of herpes over the left side of the forehead, sharply delimited by the median line. The skin, up to the edge of the hair, was reddened, swollen, and presented a considerable number of papule-like elevations, but there was no pain and no hypersensitiveness of the skin. The scalp was not unduly sensitive to rubbing and pulling of the hair. Two hours later this rash had completely disappeared.

Three days later the conjunctiva was less turgescent. Another application of bluestone was followed by a less marked rash in the same situation. The skin was elevated slightly, but distinctly, above the level of the skin on the

other side of the forehead, with a very plain line of demarcation, and was covered by little elevations with much less redness between them. Another application after an interval of two days was followed by a slighter reddening and thickening of the skin, and subsequent applications during the next week were followed by perceptible eruptions over the same area, each less observable than the preceding; then they ceased to appear. During this last week there appeared, and persisted between applications, a patch of thickened and scaly skin over an approximately triangular area on the forehead, its apex at the brow just over the left inner canthus, each leg about 5*cm* long, its vertical leg not quite coinciding with the median line. This disappeared spontaneously in about a week. During this time the turgescence of the conjunctiva steadily grew less, and its diminution seemed to proceed with equal steps with the lessening of the skin reaction. The patient was under observation two and a half months longer, while the disease took its usual slow course to recovery without suppuration of the glands. Although several attempts were made to again excite a reaction of the skin by an application of bluestone, no such reaction could be again discerned.

This case is reported because of the peculiar reflex effect produced on skin supplied by the ophthalmic branch of the fifth nerve as the result of an irritant applied to the filaments of the same nerve in the conjunctiva. At least, that is my interpretation of the phenomena observed. These phenomena were a fugitive herpetic rash, which on no occasion lasted two hours, and a dry eczema, which lasted about a week. My knowledge of cutaneous affections does not qualify me to discuss such conditions discursively. It is my impression that transient attacks of eczema have been met with, and that eczema has occasionally been ascribed to a reflex origin, but if I have ever read of such a fugitive herpetic eruption as the one just described, the fact has escaped my memory.

Satisfactory answers have not yet been obtained to two questions: If this was truly a skin reflex induced through the medium of the fifth nerve, why was not the skin hypersensitive? Did the turgid condition of the conjunctiva predispose in any way the conjunctival filaments of the fifth nerve to the excitation of a skin reflex, or was its diminution *pari passu* with that of the skin reflex merely a coincidence?

REPORT OF THE PROCEEDINGS OF THE SECTION ON OPHTHALMOLOGY OF THE NEW YORK ACADEMY OF MEDICINE.

By Dr. C. BERENS, Jr., Secretary.

DR. A. E. DAVIS, CHAIRMAN.

A meeting of the Section on Ophthalmology was held at the New York Academy of Medicine on Monday evening, May 17, 1920.

PRESENTATION OF PATIENTS.

Dr. L. W. Crigler presented a case of **unilateral postural exophthalmos.**—A. S., male, age 34, was first seen on March 23, 1920. His chief complaint was severe pain and protrusion of the right eye whenever he bent his head forward or stooped over; as long as his head was held upright he was all right. He first noticed this condition about two years ago. Previous to that time he had suffered from recurrent attacks of nosebleed for several years. There has been no recurrence of the nosebleed since the exophthalmos began.

Two years ago he had an attack of jaundice which lasted about one month, followed by complete recovery. Once or twice during the past two years he has lost consciousness for a few minutes at a time; his general history is otherwise negative.

A most thorough physical examination failed to elicit any abnormality, aside from a slightly dilated vein on the anterior faucial pillar on the right side.

Nothing was revealed by means of the X-ray although radiograms were taken of the head, neck, and thorax. The gall bladder was likewise negative.

Blood Wassermann and chemical blood were both negative.

The eyes in their normal position show no difference in degree of protrusion but by having the patient bend his head forward between his knees for a half minute there is a gradual protrusion of the right eye; measured on the exophthalmometer this equals as much as four or five *mm.* The tissues surrounding the eye, as well as the temporal vein, become distended.

Vision, refraction, and fields in both eyes are normal.

Ophthalmoscopically the fundus picture does not change during the protrusion although the patient states that his vision is temporarily slightly obscured. The patient experiences no head noises nor can pulsation or bruit be detected at any time.

Diagnosis: Varicosity of the orbital veins.

Ætiology: Undetermined.

Prognosis: Favorable as to retention of vision.

Treatment: No operative measures advised as long as further symptoms do not develop.

Among the several causes advanced in explanation of this unusual condition, that of Birch-Hirschfeld seemed most plausible, namely, the presence of a retro-sternal goiter interfering with the return flow of blood to the heart.

An anomalous cervical rib, sometimes advanced as a cause, was excluded by means of the X-ray.

Dr. GEORGE H. BELL demonstrated a patient with **embolism of central artery of the retina** on which he performed an early paracentesis. The patient, age 28, came to see him March 12, 1920, stating that while combing her hair that morning she noticed that she suddenly lost the sight of her right eye. Dr. Bell saw her about two hours after the accident. The ophthalmoscopic examination revealed the fundus picture of embolism of the central artery.

There was marked arterial anæmia of the retina. The white, cloudy, œdematous looking opacity appeared at the posterior pole and gradually extended over the entire fundus. The fovea centralis retained its normal color, appearing as a "cherry red spot." The arteries were very small. The veins were reduced in size and the optic disk was pale. The pupil was widely dilated and did not react to light. T. was N. The patient had light perception only.

There was no time for delay, so Dr. Bell did a paracentesis of the cornea at once in his office. The A. C. filled so rapidly that it was emptied for the second time after which a pressure bandage was applied. The treatments after the operation consisted of massaging the eyeball once daily and nitroglycerin internally.

Ætiology: The patient has a presystolic murmur, and Dr. Bell believes that a vegetation from the mitral valve caused the embolus. The patient's blood pressure is normal; urine normal; X-ray of teeth, neg.; Wassermann, neg.

The fundus has now, two months afterwards, returned to its normal color, and there is an atrophy of the nerve. The markings of the lamina cribrosa are invisible, indicating that the atrophy is of retinal origin. The arteries are very small, but not the white bloodless cords that we generally see following embolism.

The pupil now reacts to light. Vision, fingers at five feet.

Dr. CRIGLER said that he had seen the patient before and after the paracentesis and believed the operation had aided in the restoration of vision.

Dr. GEORGE H. BELL demonstrated a patient with **thrombosis of central vein of the retina** in a man, age 32. He first saw this man on February 2, 1920, when he said he could not see with his left eye.

He had been working for the Government for the last ten years. His lunch every day consisted of sweets—milk, chocolate, cakes, and pastry. The patient had been on this diet for a long time, not knowing that sugar was a toxic substance. When he was first seen, V. O. D. = $\frac{20}{40}$; V. O. S. = light perception. On examining the fundus of O. S., the outline of disk was obscure. The entire fundus was covered with blood. An almost continuous sheet of blood extended over the disk and to the temporal side. The veins were enormously distended and buried in the swollen retina, except in places where there were venous loops. The arteries were all obscured.

Tension of eye was *20mm*. Urinalysis showed 3.1% sugar, no albumin, with sp. gr. 1030. X-ray of teeth, negative; examination of cardio-vascular system was negative; Wassermann was negative. Tonsils had been enucleated. A chem-

ical examination of blood at P. G. Hospital showed urea n. 11.9, creatine 1.9, sugar .182.

This patient had a thrombosis. It was possibly caused by the action of the sugar on the endothelial cells.

Statistics confirm the increasing prevalence of diabetes as the consumption of sugar increases.

Now, at this time, two months later, a great many of the hemorrhages have been absorbed leaving behind some white areas. Some of the veins are still distended. There are some fine vessels of new formation on the disk.

Dr. Bell demonstrated this patient for two reasons: first, that a thrombosis in a man 32 years of age is very rare and also it is unusual to find diabetes in a man of his age; second to demonstrate the effects of the diet on the eye even in the young. V. O. S. = Hand movements at 10 feet. V. O. D. = 20:20.

Dr. A. J. HERZIG read a report of a case of **cavernous sinus thrombosis** in a child of five years.

The child had had no previous history of infectious disease or illness that he could ascertain; except that she complained of a headache occasionally during the past year. Patient became ill on February third complaining of headaches. Temp. 102° which later came down to 101.2° and after that fluctuated between these degrees where it remained until February 8th, when it went to 104°. Two pediatrists saw the child daily and treated the patient symptomatically until February 8th, when a swelling at the outer and upper side of the right eye was first noticed. Dr. Herzig saw the patient first on February 8th. In addition to the ocular findings a right otitis media was present. Child semiconscious at this time. Right exophthalmos, right eye, fundus showed dilated veins. Left eye, fundus negative. He incised the right tymphanic membrane and then incised the orbital abscess. He obtained a drop of a dark-brown fluid which upon culture showed staphylococcus citreus. He felt he was dealing with a retro-bulbar abscess with origin in the ethmoid region. He had intended to operate upon the nose the following day. That evening the temp. having risen to 106°, the child was removed to St. Luke's Hospital where he entered the orbital cavity and broke down all the bone in the ethmoid region. It

was not until he reached the posterior cells that he encountered pus which he drained into the nose. The culture from this pus subsequently showed the staphylococcus citreus. The temperature at the time of operation was 107.2°. On February 9th at 1 a. m. the temperature dropped to 102.4° and later rose to 108.8° when he was again summoned and redressed the wound at the same time gently curetting the wound and removing a few blood clots and debris. At 8 a. m. the eye was almost completely proptosed and the cornea was cloudy. X-ray at this time showed the posterior ethmoid region cloudy and also the space left by the removed bone. Blood culture at this time showed 125 colonies of staphylococcus citreus to 1cc. Blood count showed 25,000 cells, 80% polymorphonuclear leucocytes, 20% lymphocytes. Urine examination showed only a faint trace of albumen. At this stage the patient showed all signs of meningitis for the first time. A spinal puncture showed a cloudy fluid under considerable pressure and later culture demonstrated two colonies of staphylococcus citreus, 2800 cells positive butyric, 90% polymorphonuclear leucocytes and 5% lymphocytes. Dr. Wiener in consultation diagnosed the case as one of cavernous sinus thrombosis, all signs of a paralysis of the 3d, 4th, and 6th nerves and anæsthesia of the cornea being present. There was anæsthesia of all branches of the first division of the 5th nerve. The patient died at 10 p. m. the same day without regaining consciousness. The case is interesting in the fact that it occurred in a child of five years, and also that from the time the eye became proptosed until death took place only 30 hours had elapsed.

Dr. W. P. EAGLETON said we do not operate early or radically enough in sinus thrombosis as we usually mistake it for orbital abscess. They are generalized infections with infected blood current. If the blood culture is positive the eye should be enucleated and the cavernous sinus opened. If this is done, there is some hope for recovery.

Dr. JOHN GUTTMAN in reporting a case of **macular hole in the retina** said: "A patient, H. R., came to me with the history that he could not see with the left eye. Subjective examination of the left eye showed a total loss of vision. Ophthalmoscopic examination showed a round red disk the size of the papilla, in the region of the macula lutea, simulating

an effusion of blood with very sharply defined border. The bottom was dark red. He attributed the cause of his affection to a fall from his bicycle when the opposite side of his head, *i. e.*, the right side, struck the pavement. The injury of his eye was therefore caused not by a direct blow on that eye, but by contre coup."

Dr. B. W. KEY presented a patient with **penetrating wound of the eyeball** with infection treated by **anti-diphtheritic serum.**

W. D., 42 years of age, February 25th was struck in the right eye by a sharp piece of metal, which penetrated the cornea, iris, and lower margin of the lens. He was sent to the Infirmary at once. X-ray was negative. In 48 hours infection was evident, the lids swollen, violent conjunctival and iritic reaction, purulent exudate in anterior chamber, and apparently a similar involvement in the vitreous. Pain was intense. Subsequently the anterior chamber was filled with purulent exudate so that the pupillary space was obscured.

His treatment was limited to hot bathing and 2000 units of anti-diphtheritic serum every three to four days while at the hospital, which was about two months. There was early relief of pain (in 48 hours). After the first violent onset of the infection, the eye gradually quieted till it now presents a painless, mildly inflamed globe, tension a trifle sub-normal, a cataractous lens, a clear and transparent anterior chamber and pupillary space.

While vision is hopelessly lost and it may become necessary later to remove the globe, the behavior of this infection is very unusual, and quite significant of the systemic effect of anti-diphtheritic serum in combating severe ocular infection.

Dr. W. E. LAMBERT said, regarding the use of anti-diphtheritic serum in ocular infection that he had seen a number of cases in which it would seem that the use of the serum had had a decided, beneficial effect, but it is impossible to say whether or not the same result may not have been obtained with the usual treatment, without the serum. It is therefore difficult to say how much real benefit the use of the serum is.

Dr. KEY presented another patient with **bullet wound of both orbits** with unusual complications.

Mrs. J. P., aged 50 years, consulted him April 17, 1920, and

gave a history of being shot through the right eye, with sudden loss of vision in the left eye one month before. The right eye was removed a few days after the accident and she was discharged from the hospital after three or four weeks.

On examination there was a deeply notched scar of the right upper lid, the orbital tissues and conjunctiva drawn toward the nasal side of the orbit. The left eye appeared entirely normal except that the pupil was slightly dilated and reacted sluggishly to light.

The ophthalmoscopic examination revealed a fairly clear vitreous, but a profuse retinal hemorrhage completely covering the papilla, and extending nasalward, upward and downward for a distance of about three discs diameters. The macula region was clearly visible, but marked by early atrophic changes. Vision was limited to fingers at five feet nasalward. An X-ray revealed the bullet in the left maxilla at the lower temporal angle of the bony orbit, also numerous small portions of it in the tissues of left orbit behind the globe.

This case is presented because of the interesting character of the injury, also for a diagnosis and prognosis.

Dr. K. SCHLIVEK reported a case of **oxycephaly.** N. J., age 28 years.

No other member of the family had skull deformities.

Cannot get history of early life (parents are dead). Went to Hebrew school at five years and was through at thirteen; apparently the same mental development as the other boys in his town. Then started to work in a dress-goods store and from that time remembers he had difficulty with colors. At twelve years of age he knew that O. D. was blind. At fourteen years he came to this country and worked as an errand boy. Is quite as capable at his present work as the other men are but finds great difficulty with colors.

Patient came to Dr. Wheeler's clinic at the New York Eye and Ear Infirmary. Chief complaint is inability to distinguish colors.

Exam. V. O. D. Fingers at six inches. O. S. $\frac{1}{10}$. There is exophthalmos; measured with Hertel's exophthalmometer 23mm each eye. Divergent strabismus O. S. and this is concomitant. There are no paralyses and no nystagmus.

Fundi O. D. nerve head is white, margins are irregular,

physiological cup is fuzzy. Slight narrowing of the arteries and there is some perivasculitis. O. S. nerve head is white except for a little faint pink in the nasal part, margins are irregular, physiological cup is fuzzy.

Fields O. D. show very marked concentric contraction and no color perception; it is difficult for the patient to fix. O. S. slight contraction of fields for form, marked contraction for blue and no perception of red or green.

Head is of the characteristic oxycephalic type. Vertical diameter very high, side to side and antero-posteriorly, diameters are small. Forehead is high and slopes slightly backward. Measurements—fronto-mental 19cm. Nasion to chin 12½cm. Biparietal 14¾cm. Occipito-frontal arc (nasion to opisthion) 15½cm.

X-ray by Dr. Dixon.

Has well-developed frontal sinuses. Neither the frontals, ethmoids, nor antra are clear as they should be. Nasal septum is deviated to the left. The sella is large and of the semi-inclosed type. It measures 10 x 18.5mm and the square content is 194 sq.mm,—all corrected. It lies very low, the dorsum being but a short distance above the level of the auditory canals.

The orbits are foreshortened apparently, rather than actually, the approximate distance from the glabella to the chiasm being 50mm while the angle of the roof to Reid's baseline is about 28°.

The inner table of the skull shows very distinct markings of the convolutions of the anterior lobes, and the anterior portion of the parietal.

The distance between the optic foramina (as near as can be estimated from the plates) is 21.5*mm*.

General and neurological examinations are negative.

Wasserman and urine are negative.

This is a typical case of Oxycephaly and has the characteristic symptoms, the skull deformity and the optic atrophy. It also shows the most common accessory symptoms, exophthalmos and divergent strabismus.

In these cases there is a premature closure of the sutures in the posterior portion of the skull and this allows the brain to grow and expand only in the direction of the anterior part of

the skull. There is increase of intracranial pressure, with its choked disc and later secondary atrophy. In the stage of development there very often are headaches and convulsions. This condition is much more common in males than in females 5:1.

The family history generally is negative although there are few cases reported in the same family. Intelligence is generally unimpaired unless blindness hinders the development.

Prognosis: The condition will not progress.

Treatment should be directed to the alleviation of the intracranial pressure during the stage of development *i. e.*, before the seventh year.

Dr. W. P. EAGLETON reported a case of **pulsating exophthalmos** with **ligation** of the **ophthalmic vein.**

Dr. A. E. DAVIS presented a patient with **bilateral glioma.**

Bertha C., aged 17 months, was seen by him for the first time May 15, 1920. The mother gave the following history of the case. Healthy child at birth, at three months of age noticed that the left eye "looked like a cat's eye in the dark." Consulted an oculist who advised enucleation but this was refused. Two months later, the right eye was similiarly affected as the left. Mother has done nothing for the patient. Present condition of the patient: Right eye: Interior of eye is half filled with yellowish white mass with blood vessels in the mass; at one point there is a "flame-like" or "sheet" of blood vessels on the anterior surface of the glioma. Pupil active and quick perception of light. Tension normal. Left eye: The entire fundus is filled with a yellowish white mass with blood vessels in it. Pupil somewhat sluggish to direct light action. Whole eye slightly enlarged, especially at the equator. Tension somewhat increased. Child is fretful and cries at night. As it is too late to operate mother was advised to try Selenium under Dr. C. H. Walker's direction. The mother has lost one other small child with "cancer of the eye" of eight months' duration.

PAPERS OF THE EVENING.

Dr. DERRICK T. VAIL read by invitation a paper on **detachment of the retina.** (Appears in full in this issue.)

A paper on **further experiences with trephining and aspiration in retinal detachment** was read by Dr. EDGAR S. THOMSON (appears in this issue).

DISCUSSION: DR. ARNOLD KNAPP: Detachment of the retina is a very timely topic, for there is no subject in ophthalmology in which we require more knowledge and newer ideas. Dr. Vail has reviewed a number of important and fundamental facts and has given us some interesting and stimulating deductions. The idea of a peripheric choroiditis being the cause of detachment of the retina is plausible. We know that the region of the ora serrata is a vulnerable one, and that in extraction of foreign bodies from the back of the eye incisions through this part of the eyeball are very apt to be followed by detachment. The neighborhood to the ciliary processes also explains the frequency of iritis in detachment of the retina. On the other hand peripheric choroiditis which is so strikingly seen in inherited syphilis is not usually followed by detachment of the retina. The rôle of the aqueous arrest is interesting, though, I fear, theoretical, and I am free to confess my inability to follow a discussion on osmosis.

Dr. Vail's views on treatment are conservative and justly critical. He apparently does not object to sclerotomy, trephining, or subconjunctival salt injections, and believes that the favorable action of these procedures must be due to their influence upon osmotic phenomena. I am very glad to agree with and confirm Dr. Vail's views that the advance in the treatment of detachment of the retina must necessarily depend upon further knowledge of the chemistry and physiology of the vitreous body.

Dr. J. H. CURTIN said that Dr. Vail spoke of the importance of the ætiology or the underlying condition causing retinal detachment; that the condition of retinal detachment was a symptom as much as an iritis, choroiditis, or any other local eye condition; that it is simply a local manifestation of a general systemic condition in the majority of cases; that in the study of our cases the underlying condition should always be diligently sought for but that in nearly all were we baffled in our search.

Urine and blood examinations, focal infections including the examination of the sinuses, teeth, tonsils, gastro-intestinal

tract, stomach, and fecal examinations were made and in only one case could we definitely state the underlying conditions, that being the case of chronic interstitial nephritis.

We have obtained some results in the treatment of retinal detachment by scleral trephining and aspiration while all other measures have been failures in our hands, and until some better means are given us we will continue in our operation in selected cases.

Dr. W. E. LAMBERT stated that his experience with the trephine operation for detachment of the retina had been most disappointing, as in none of the cases has the result been other than temporary. The only cure he had was one of spontaneous reattachment, which occurred some months after a cataract extraction. The patient was kept in bed for several weeks after operation was made and no result obtained. Six months later she presented herself with the complete reattachment and restoration of the function. This has remained so for the past five years.

Dr. A. E. DAVIS: Dr. Vail states that in those patients in which the retina reattaches, there is always a white line of demarcation at the junction of the healthy and the formerly detached retina. I wish to confirm this observation so far as it applies to one of the only two cases of detachment of the retina in my experience which have become reattached. This patient, a young man eighteen years of age, gave a history of a fall from a cradle when a child. When seen by me he had detachment of lower half of the retina in the left eye and a white line horizontally across the fundus demarcating the attached portion of the retina from the detached portion. The patient remained under my care for eleven years without any change taking place in the detached retina, either as to increase or decrease. He was then sent to the country on account of apical tuberculosis. He returned to the city six years later greatly improved in general health, having gained thirty pounds in weight, and to my surprise with a complete reattachment of the retina. The white connective tissue line or band still demarcates the attached and reattached portions of the retina; but in addition the temporal side of the retina has two supplemental white bands just below the original band and parallel with it.

Dr. THOMSON in closing stated that he wanted to lay particular stress upon the importance of the aspiration. It was almost possible to tell from the ease with which the fluid was aspirated what the final outcome of the case would be. If the fluid comes out well, there is some chance of success; if the retina does not go back into position properly but remains pouched and wrinkled the chances are poor. He agreed with Dr. Vail that the search for the underlying cause of detachment of the retina was most important.

REPORT ON THE PROGRESS OF OPHTHALMOLOGY FOR THE SECOND, THIRD, AND FOURTH QUARTERS OF 1919.

Edited by MATTHIAS LANCKTON FOSTER, M.D., F.A.C.S.,
New Rochelle, N. Y.

I.—GENERAL OPHTHALMIC LITERATURE.

1. DUANE, A. **The eyes of the signalman.** *American Journal of Ophthalmology*, August, 1919.
2. FISON, A. H. **Positions of focal lines of a small cylindrical beam of parallel rays traversing the center of a thin symmetrical double convex lens.** *British Journal of Ophthalmology*, June, 1919.
3. GREENWOOD, A. **The organization and activities of the ophthalmic service in the American expeditionary forces.** *American Journal of Ophthalmology*, August, 1919.
4. MACCALLAN, A. F. **Causes of blindness in Egypt.** *Ibid.*, October, 1919.
5. MADDOX, E. E. **Venesection as a preventive for expulsive hemorrhage.** *Ibid.*, January, 1920.
6. MOREAU, F. **Hysterical amblyopia.** *Annales d'oculistique*, clvi., 3.
7. PANNI, N. P. **The "Tecnomyopic" test for simulators or those who exaggerate amblyopia.** *Ibid.*, clvi., 4.
8. VAN DER HOEVE, J. **Eye lesions produced by light rich in ultraviolet rays. Senile cataract, senile degeneration of the macula.** *American Journal of Ophthalmology*, March, 1920.
9. WIENER, M. **School of ophthalmology at Camp Greenleaf.** *Ibid.*, May, 1919.

DUANE (1, **The eyes of the signalman**) after two years' experience in the training of men in signaling concludes that the American flags could be improved if the blues and reds were lighter and the yellows deeper. The ocular requirements should be considered in connection with other physical and mental qualifications. Men otherwise fit, with uncorrected

vision of $\frac{2}{10}$ or less, might be accepted since glasses are only a relative handicap.

ALLING.

GREENWOOD (3, **The organization and activities of the ophthalmic service in the American expeditionary forces**) presents an authoritative history of the ophthalmic service including a description of the various hospitals, the character of the cases treated, the optical department, and suggestions as to the improvement of the service. A list of the personnel is appended.

ALLING.

FISON'S paper (2, **Positions of focal lines of a small cylindrical beam of parallel rays traversing the center of a thin symmetrical double convex lens**) is a *bonne bouche* to the mathematically inclined but is *caviare* to the general reader. It is not suitable for abstraction and would be incomprehensible without the diagrams.

T. HARRISON BUTLER.

From statistics compiled by MACCALLAN (4, **Causes of blindness in Egypt**) we learn that out of 85,000 cases examined during seven years who were blind in either one or both eyes 73% of the eyes were lost as the result of conjunctivitis. He states that the most frequent form is acute conjunctivitis without further explanation and that trachoma is not a frequent cause of blindness. Glaucoma caused 11% and cataract 7.7%.

ALLING.

MADDOX (5, **Venesection as a preventive for expulsive hemorrhage**) was obliged to operate upon a patient who suffered from malaria, gout, and myœdema and had lost an eye from intraocular hemorrhage following a cataract operation. After giving quinine, a laxative, and thyroid extract he opened a vein in the temple and pricked the episcleral veins before operating. A successful result was obtained.

ALLING.

PANNI (7, **The " Tecnomyopic " test for simulators or those who exaggerate amblyopia**). The patient reads the Snellen chart with his good eye, then the vision is gradually reduced by holding increasing strengths of plus spherical lenses and the results recorded. Having established for the good eye a table of how much diminution of vision is produced by increasing

strengths of plus spheres, the author proceeds to the examination of the supposedly amblyopic eye by the same method. The answers are recorded and the examination repeated the next day if necessary. Comparing the findings in both eyes and at different examinations will prove the veracity or mendacity of the patient.

SCHOENBERG.

MOREAU (6), describes a case of hysterical amblyopia in a woman who underwent a severe mental shock during a bombardment.

SCHOENBERG.

VAN DER HOEVE'S (8, **Eye lesions produced by light rich in ultra-violet rays**) line of reasoning is ingenious. By experimentation light rich in ultra-violet rays has been shown to produce opacity of the lens, changes in the posterior layer of the iris and ciliary processes, as well as degeneration of the retina and choroid. The lens absorbs light of short wave length producing phosphorescence and diffusion of light throughout the lens, thus reaching the posterior surface of the iris and the ciliary body. Cataract is produced by lack of nutrition due to the disturbance in the ciliary body. Lenses differ in their ability to absorb these rays, hence in some individuals they reach the macula and cause degeneration. Macular degeneration therefore does not occur in cataract cases. Cataracts occur in India, where the light is intense, about ten years earlier than in Europe. Would it be possible to attribute gray hair, arteriosclerosis, and general loss of vitality of the body cells in senility to ultraviolet rays?

ALLING.

This paper by WIENER (9, **School of ophthalmology, Camp Greenleaf**) gives details of the schedule and actual work of the camp school.

ALLING.

II.—RELATIONS OF OPHTHALMIC TO GENERAL DISEASES. POISONS.

10. BARKAN, H. **Ocular angioneurotic œdema and glaucoma.** *American Journal of Ophthalmology*, November, 1919.

11. BELL, G. H. **Relation of teeth, tonsils, and intestinal toxæmias to diseases of the eye.** *Journal American Medical Association*, Oct. 11, 1919.

12. CLAPP, C. A. **Detachment of the retina in eclampsia and toxæmia of pregnancy.** *American Journal of Ophthalmology*, July, 1919.

13. CONLON, F. A. **Conjunctivitis due to food anaphylaxis.** *Ibid.*, July, 1919.

14. CRAIG, J. A. **A case of poisoning by homatropine.** *British Journal of Ophthalmology*, June, 1919.

15. DESAI, H. M. **A case of congestive glaucoma after the use of homatropine and eserine.** *Ibid.*

16. DICKINSON, W. G. **Ocular manifestations of cerebral syphilis.** *American Journal of Ophthalmology*, February, 1920.

17. FISHER, J. HERBERT. **Migraine.** *British Journal of Ophthalmology*, June, 1919.

18. FRADKINE, S. **Two cases of concentric contraction of the visual fields without hysteria.** *Clinique ophtalmologique*, viii., 3.

19. GALLEMAERTS. **Ophthalmic zona.** *Annales d'oculistique*, clvi., 3.

20. LUNA, R. P. **Ocular lesions consecutive to injections of antityphoid vaccine, keratitis herpetica febrilis.** *American Journal of Ophthalmology*, July, 1919.

21. LUNA, R. P. **Disturbances of vision in patients harboring filarial tumors.** *Ibid.*, November, 1919.

22. MORET. **Ocular disturbances in ictero-hemorrhagic spirochetosis.** *La clinique ophtalmologique*, viii., 1.

23. PENICHET, J. M. **Ocular complications of peripheral epilepsy.** *American Journal of Ophthalmology*, August, 1919.

24. TAYLOR, J. **Changes in the sella turcica in family optic atrophy.** *British Journal of Ophthalmology*, May, 1919.

25. TERSON, A. **Ocular diseases of buccal origin.** *La clinique ophtalmologique*, viii., 2.

BARKAN'S (10, **Ocular angioneurotic œdema and glaucoma**) patient was a woman of 52 who suffered from frequent attacks of angioneurotic œdema of the face. In connection with some of these attacks she would complain of dimness of vision and congestion of the eye. The œdema lasted no longer than an hour and the tension decreased promptly under eserine. After seven years the eye showed no permanent changes. He attributes the phenomenon to a localized œdema of the uveal tract.

ALLING.

BELL (11, **Relation of teeth, tonsils, and intestinal toxæmias to diseases of the eye**) emphasizes the importance of these causes of eye inflammation. He thinks that sugar is a solid alcohol and aids fermentation in the stomach leading to the formation of toxins.

ALLING.

CLAPP (12, **Detachment of the retina in eclampsia and tox-**

æmia of pregnancy) relates six cases of retinal detachment which he observed at the Maryland Lying-In Hospital during the past year and a half. The condition is a rare one if one were to judge by the absence of recorded cases, but he believes that more thorough examinations would show that they are fairly frequent. The lesions varied from small peripheral elevations to almost complete detachment. In all these cases the retina has become reattached although the ultimate vision may be defective on account of the injury produced by the neuroretinitis. The detachments were undoubtedly due to the transudation of fluid under the retina and were not accompanied by tears.

ALLING.

CONLON (13, **Conjunctivitis due to food anaphylaxis**) is convinced that certain lesions of the eye especially conjunctivitis, are produced by food to which the individual is sensitized.

In one case the eyelid became swollen and the conjunctiva hyperemic whenever the patient ate strawberries or tomatoes. Even the use of tomato catsup had the same effect. Another patient seemed to be troubled only when he ate eggs and still another after indulging in flounders. He recommends the protein skin test which consists in applying various proteins to skin abrasions and noting the local reaction which, when positive, appears as an urticarial wheel surrounding the cut.

ALLING.

CRAIG'S (14, **A case of poisoning by homatropine**) instructive case history runs as follows: A. B. æt. 3½ was refracted under atropine which in 1% solution was instilled twice daily for three consecutive days. There were no toxic symptoms. Two years later homatropine was employed, the child being 5½ years old. A drop of 1% solution was instilled into each eye. Two hours later the child was in a state of intense mental excitement with visual hallucinations. She complained of a dry mouth. The excitement continued for ten hours when the child fell asleep and awoke normal five or six hours later.

T. HARRISON BUTLER.

A reminder that the use of a mydriatic in the middle-aged is not free from danger is always salutory, the more so when some ophthalmologists advise the routine use of a cycloplegic for refraction. DESAI'S (15, **A case of congestive glaucoma**

after the use of homatropine and eserine) case is as follows: Mrs. S. B., æt. 48, was refracted after the instillation of a 1% solution of homatropine. Eserine in 1% solution was employed before the patient left. The refraction was plus 4.5 D. The same night severe pain came on, and three days later she returned with acute glaucoma the tension being 45 Schiotz units. Eserine failed to control the tension so an iridectomy was performed. This operation was only partially successful the tension remaining at 25. A sclero-corneal trephining reduced the tension to 15. The refraction was reduced by the operation to 2.5 D. and the vision from $\frac{9}{6}$ to $\frac{6}{18}$. The refraction was still 2.5 six months later.

The reviewer has had two similar cases after the use of homatropine followed by eserine. In one case the tension was not reduced by sclerectomy, and the eye was eventually lost. In the other glaucoma developed in both eyes, both were trephined but in only one was the sight saved.

T. HARRISON BUTLER.

DICKINSON (16, **Ocular manifestations of cerebral syphilis**) states that most cases show at some time in their course, ocular palsies of the external muscles and pupillary changes. Ataxia without ocular paralysis may be observed. Anomalies of the field of vision are common often showing reduction of the temporal fields. The media are usually clear but retinitis may occur and optic nerve changes are quite constant varying from mild neuritis to choked disk. ALLING.

FISHER (17, **Migraine**) who has been a life-long sufferer from migraine suggests that alterations in the pituitary body may be the cause of the disease, and the line of reasoning that he develops lends strong support to the interesting hypothesis. The classical symptoms of the disease are the scintillating scotoma, the typical headache, and the final vomiting. In addition Fisher himself notices that the attacks are always accompanied by a slow pulse and by polyurea. There is also an extreme feeling of depression. The scotoma is often associated with hemianopsia. In the female the attacks often coincide with the catamenia and cease during pregnancy, they tend to disappear at the climacteric. In the male, too, the disease commonly terminates at about fifty when the sexual functions are becoming inactive.

The migraine spectrum is always symmetrical; it may be represented by a scotoma spreading from the central point of vision; it may first appear in the temporal halves of the fields, or may affect homonymous halves of the retina. If flashing light sensations appear homonymously they will be followed by hemianopsia in the half fields implicated.

Fisher thinks that these sensations could be produced by irritation of the nerve fibers at the base of the brain. Implication of the chiasma would explain the expanding central scotoma, and the bitemporal scotoma. Affection of the tract would cause the homonymous spectrum. There is only one region, the interpeduncular, where pressure could cause these varied effects. Fisher suggests that swelling of the pituitary body is the mechanical agent which causes the irritation of the nerve fibers, and points out that alterations in the pituitary secretions would account for the other symptoms. The enlargement of the gland would in addition raise the intracranial pressure and give rise to the headache, the vomiting, and the slow pulse.

At the menstrual epoch, the climacteric, and during gestation, the pituitary body is profoundly affected, hence the liability to an attack during menstruation and the termination of the disease when the sexual functions fail. The increased renal activity too is explained upon the same grounds for the pituitary secretes a hormone which stimulates the kidney to increased secretion. Fisher has examined the sella turcica by the X-rays with negative results.

Fisher is not the first surgeon who has connected the pituitary body with headaches. Irving H. Pardee of New York (*Archiv. Internat. Medicine*, February, 1919) makes a similar suggestion and his line of argument is similar to Fisher's. He, however, states that the sella turcica is generally found by Roentgen ray examination to be altered in various ways.

T. Harrison Butler.

Fradkine's (18, **Two cases of concentric contraction of the visual fields without hysteria**) first patient had a marked visual field contraction of the left eye with no other findings to explain its cause. A careful examination revealed that the patient was a malingerer. The second case had contraction of

the visual fields, reduced acuity of vision and marked asthenopia by reading. A neurologic examination showed the existence of a mild meningitis (increase of globuline and white cells in the spinal fluid). The gradual subsidence of the meningeal process was followed by a complete disappearance of the ocular symptoms.

SCHOENBERG.

GALLEMAERTS (19, **Ophthalmic zona**) reports a case of this nature met with in a child five years old.

SCHOENBERG.

LUNA (20, **Ocular lesions consecutive to injections of antityphoid vaccine**) observed a case of herpetic keratitis following a catarrhal inflammation of the upper air passages from which the patient entirely recovered. Three years later he was given a polyvalent antityphoid vaccine and within two days developed superficial ulcerations of the cornea with anæsthesia. The author reviews our knowledge of the subject of ocular reactions following the use of the vaccines and concludes that no lesions can be said to depend exclusively upon the injections but herpes may develop, especially if there is a predisposition. The vaccines may also light up an old iridocyclitis and it is well to avoid the injections in luetic, tuberculous, and rheumatic patients who have had lesions of the uveal tract. Some cases are evidently purely coincidences.

ALLING.

LUNA (21, **Disturbances of vision in patients harboring filarial tumors**) describes a condition of the cornea in these cases which he attributes to toxins produced by the filaria and absorbed into the system. The lesion consists of minute deposits in the anterior layers of the cornea extending from the periphery toward the center but never including the pupillary area. The opacity is so dense that it resembles the sclera. Removal of the tumors, which are usually in the scalp is the only remedy.

ALLING.

MORET (22, **Ocular disturbances in ictero-hemorrhagic spirochetosis**) describes these disturbances as follows: (a) In the acute period of the disease there is a congestion and sometimes hemorrhages in the conjunctiva and uvea. Acute iritis is not an unfrequent occurrence. (b) In the period of decline

the patient complains of asthenia and the ophthalmoscope reveals retinal anæmia or neuroretinitis.

SCHOENBERG.

PENICHET (23, **Ocular complications of peripheral epilepsy**) reports the case of an epileptic who had only a few sensations of light before his attacks and a contraction of the fields following, but after every fit there was a profuse hemorrhage into the anterior chamber and subconjunctival ecchymosis. The blood disappeared completely in from 20 to 30 days. Another case showed paresis of the orbicularis with ptosis and complete anæsthesia of the skin in the infraorbital region. These disappeared regularly after each seizure.

ALLING.

TAYLOR (24, **The sella turcica and family optic atrophy**) brings forward two more cases which help to support Fisher's theory that Leber's disease is dependent upon changes in the region of the pituitary body. Leber in his original paper published in 1871 noted the occurrence of familial optic atrophy in patients who were subjects of nervous symptoms, such as headache, vertigo, tremors, and even epileptic attacks. Also that the optic atrophy was not infrequently preceded by some degree of optic neuritis, and that while central scotoma for color and failure of central vision were characteristic, contraction of the fields was rare. Fisher pointed out that it was difficult to maintain the theory that Leber's disease was caused by a retrobulbar neuritis. Taylor's two cases were brothers who belonged to a family which has furnished several cases of Leber's disease. Observations on these cases were published by Taylor and Holmes (see *Trans. Ophth. Soc. U. K.*, vol. xxxiii). The paper contains a skiagram of the sella turcica region of both patients and they reveal characteristic changes in the sella turcica which is long and shallow with alterations in the clinoid processes. One X-ray picture was taken within a few months of the onset of symptoms. Taylor holds that these examples uphold Fisher's theory for in each the sella turcica is not normal.

T. HARRISON BUTLER.

TERSON (25, **Ocular diseases of buccal origin**) calls our attention to the errors we are prone to make when diseased

teeth coexist with an eye trouble. Without denying the ætiological importance of dental infections, the author is rather inclined to believe that there is a link between the eye disease and the tooth process, and that link is a "dyscrasia" or "diathesis" which predisposes the ocular tissues to the localization of the infection. The logical conclusion is to treat the general condition at the same time we attempt to eradicate the focus of infection.

SCHOENBERG.

(*To be continued.*)

NOTICE.

ROYAL LONDON OPHTHALMIC HOSPITAL.

(Moorfields Eye Hospital)

CITY ROAD, E.C. 1.

Patrons, His Majesty the King.
Her Majesty the Queen.
Her Majesty Queen Alexandra.
President, His Royal Highness Prince Arthur of Connaught.

This Hospital, established 116 years ago, and best known throughout the civilized world by its popular name "The Moorfields Eye Hospital," is the parent of all similar institutions throughout the English-speaking world.

In 1811, Dr. Edward Delafield and Dr. J. Kearney Rodgers, then young men who had recently graduated in medicine at the College of Physicians and Surgeons in New York, came to London and studied at this Hospital under Dr. Farre and Mr. Benjamin Travers. On their return to their own country in 1818, so impressed had they been with all they had seen and learnt at the London Eye Infirmary, as it was then called, that they determined to establish a similar institution in America. This they succeeded in doing, and in August, 1820, "The New York Eye and Ear Infirmary" commenced the great and beneficent work which it continues to carry on at the present time.

In 1816 Dr. Edward Reynolds came from Boston, Mass., to London to pursue his medical studies. He attended the practice and lectures at this Hospital under Mr. Benjamin Travers and Sir William Lawrence. On his return home he found his father blind from cataract in both eyes. With rare courage,

fortified by his recent experience in London, he decided to operate. Happily the operation proved a complete success. It had never been undertaken in Boston before. It led to the foundation of Dr. Reynolds's reputation as the leading surgeon in diseases of the eye, and to the foundation in 1824 of "The Massachusetts Charitable Eye and Ear Infirmary," which still exists as a center of light and leading.

Ever since these fathers of Ophthalmology in the United States came to study at this Hospital there has been a continuous succession of American medical men working in its wards, its operation theater, its out-patient department, and its laboratories.

Nurses, like medical men, who are engaged in the treatment of diseases of the eye require special training beyond that which is provided for them in their ordinary curriculum. Moorfields Hospital aims not only at supplying all that is required for training Ophthalmologists but also to supply suitable training for Ophthalmic nurses. Many nurses who have received such training at this Hospital have gone from it to take up similar work in various parts of the British Empire and America.

Immense progress has been made in Ophthalmology since the Hospital was first established, and much of this has been effected by the researches of the many distinguished surgeons who have served on its staff.

Many further advances are ripe for investigation in several different directions, but can only be carried out if the necessary means are forthcoming. Work such as this benefits not only one class, one community, or one nationality, but the whole of the human race.

Moorfields Hospital feels that, in view of what it has already accomplished and what it is striving to do in the future, it is justified in appealing for the necessary funds not only to the British but also to the American public.

It asks then for contribution towards a fund of £100,000 for the following purposes:

(*a*) To enable it to extend its laboratory accommodation for purposes of clinical and pathological research.

(*b*) To supply adequately paid assistants to the Honorary Medical Staff, which will liberate them from much of the routine work which they now have to perform, and allow of them

devoting more of their time to clinical instruction and research for which they are so eminently qualified.

(*c*) To supply adequate accommodation for the nursing staff, not only those who carry on the general work of the Hospital but also those desirous of obtaining a special training in the nursing of cases of diseases of the eye.

ARTHUR FREDERICK,
President of the Royal London Ophthalmic Hospital.

CORRESPONDENCE

541 Welbeck Street,
Cavendish Square, W. 1.
September 20, 1920.

To the Editor of The Archives of Ophthalmology.

Dear Sir:

Will you allow me to correct a misunderstanding that may arise from a remark made by Dr. Charles Maghy in your July issue?

Dr. Maghy states "In a recent letter from Colonel Elliot asking him for his statistics to compare with other authors, and those of the Moorfields Hospital, he was unable to furnish the same." I have the most elaborate notes of every single case that I have trephined since I left India, with fields, tonometer tracings, etc. I was, however, reluctantly obliged to express my inability to furnish statistics to Dr. Maghy for the simple reason that I was at the time busy on my book on *Tropical Ophthalmology* which has just appeared. This took up every minute of my spare time, and I much regret that I could not see my way to drop it, in order to analyze my statistics of glaucoma. To have undertaken such an analysis would have meant a very considerable amount of labor, for I should never be content to issue statistics for publication until I had gone into the matter very carefully indeed. With regard to my Indian statistics, Dr. Maghy knows that they are published very fully in chap. 11 of my second edition of *Sclero-Corneal Trephining*.

I am not for one moment suggesting that Dr. Maghy meant to mislead your readers; on the contrary, I am sure he had no such intention; but as the statement stands at present, it

might be misunderstood, by those who do not know the true facts of the case.

I would like to add that it was with great regret that I had to refuse Dr. Maghy's flattering request, and that simply for the reason given. I explained my difficulty fully to him in the letter he mentions. If I were to accede to all the very kind invitations of the same nature that reach me, I should be obliged to put to one side the very large mass of material which I have accumulated in my tropical work, and which will still take me several years to deal with.

Yours truly,

R. H. Elliot, M.D., F.R.C.S.,
Lt. Col., I. M. S., Ret.

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EDITORIAL NOTICE.

The Archives of Ophthalmology is a bi-monthly journal, published in annual volumes of about six hundred pages each, extensively illustrated with cuts in the text, half-tone text plates, and lithographic plates, many in colors.

About three quarters of the space is devoted to original papers, and the remaining quarter to a systematic report on the progress of ophthalmology, and to reports of societies, book reviews, and miscellaneous notes, all of it original.

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